ESO Call for Proposals – P86

Proposal Deadline: 31 March 2010, 12:00 noon CEST

Call for Proposals

ESO Period 86

Proposal Deadline: 31 March 2010,
12:00 noon Central European Summer Time

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Preparation of the *ESO Call for Proposals* is the responsibility of the ESO Observing Programmes Office (OPO). For questions regarding preparation and submission of proposals to ESO telescopes, please contact the ESO **Observing Programmes Office, opo@eso.org**.

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Part I

Phase 1 Instructions

1 ESO Proposals Invited

The **European Southern Observatory (ESO)** invites proposals for observations at ESO telescopes during Period 86 (**1 October 2010 – 31 March 2011**). The following instruments are offered in this period:

La Silla

EFOSC-2 (ESO Faint Object Spectrograph -2)
FEROS (Fibre-fed Extended Range Optical Spectrograph)
HARPS (High Accuracy Radial velocity Planetary Searcher)
SofI (Son of ISAAC)
WFI (Wide Field Imager)

Paranal

AMBER (Near-infrared interferometric instrument)
CRIRES (Cryogenic high-resolution IR Échelle Spectrograph)
FLAMES (Fibre Large Array Multi Element Spectrograph)
FORS2 (FOcal Reducer/low dispersion Spectrograph 2)
HAWK-I (High Acuity Wide field K-band Imager)
ISAAC (Infrared Spectrometer And Array Camera)
MIDI (MID-infrared Interferometric instrument)
NAOS-CONICA (High Resolution NIR Camera and Spectrograph)
SINFONI (Spectrograph for INtegral Field Obs. in the NIr)
UVES (UV–Visual Échelle Spectrograph)
VIMOS (Visual Multi Object Spectrograph)
VISIR (VLT Imager and Spectrometer for mid Infra Red)
XSHOOTER (UV–Visual–NIR medium resolution échelle spectrograph)

Chajnantor

LABOCA (Large Apex BOlometer CAmera)
SABOCA (Submillimetre APEX Bolometer CAmera)
SHFI (Swedish Heterodyne Facility Instrument)
APEX-SZ (330 channel 2 mm bolometer array)
CHAMP+ (Carbon Heterodyne Array of the MPIfR)

Proposals are also invited for observations at the Gran Telescopio Canarias (GTC) within the framework of the accession agreement of Spain into ESO. ESO/GTC proposals can be submitted for observations to be carried out between 1 March 2011 and 29 February 2012. For this call, the following instruments are offered:

CanariCam (Mid-IR camera for imaging, spectroscopy, coronagraphy and polarimetry)
OSIRIS (Optical System for Imaging and low-Intermediate-Resolution Integrated Spectroscopy)

The deadline for the submission of both ESO proposals and ESO/GTC proposals is:

31 March 2010,
12:00 noon Central European Summer Time.

In each submitted proposal, one single person, the Principal Investigator (PI), must be identified as being principally responsible for this proposal. By submitting a proposal the PI agrees that he/she and his/her collaborators will act according to ESO's policies and regulations (including the conditions specified in the present Call for Proposals) if observing time is granted.

A number of policies and procedures have been changed since Periods 84 and 85, the most important of which are highlighted below. All proposers should read the Call for Proposals carefully before submitting their Phase 1 proposal.

Any question about policies or the practical aspects of proposal preparation should be addressed to the ESO **Observing Programmes Office, opo@eso.org**. Enquiries about technical requirements of the planned observations should be sent to the User Support Department (**usd-help@eso.org**) for Paranal and Chajnantor and to **lasilla@eso.org** for La Silla.

Part I of this Call for Proposals provides information on how to complete and submit a proposal to ESO (Phase 1), Part II summarizes the capabilities of ESO telescopes and available instrumentation, while Part III outlines in detail the policies and procedures regarding proposing for, carrying out, and publishing ESO observations.

1.1 Important recent changes (since Periods 84 and 85)

- **General changes**
  - **ToO Runs:** As of Period 86, Target of Opportunity (ToO) programmes may include both observations of ToO nature and regular (non-ToO) observations. In the proposal form, the two types of observations must be requested as part of different runs; a new flag is used to identify ToO runs. For more details, see Sects. 3.2.1 and 11.4 for more details.
  - **Large Programmes:** As of Period 86, Large Programmes can no longer be converted to Normal Programmes.
  - **OPTICON:** In Period 86 ESO telescopes will not participate in the OPTICON Access Programme.
  - **Guaranteed Time Observations (GTO)** will be carried out in Period 86 with **AMBER, HARPS, MIDI, NACO, SINFONI and XSHOOTER**. For details about the planned observations, please see **http://www.eso.org/sci/observing/visas/gto/86**.
- **La Silla**
  - As in previous periods, proposals for Large Programmes on **the NTT and the 3.6-m telescope** are encouraged. Large Programmes on these two telescopes may have a duration of up to **four years**. However, for Periods 86 to 90 a large fraction (40 to 55%) of the available science time on the 3.6-m telescope is already committed to Large Programmes started between Periods 83 and 85.
  - There is a **minimum run length of 3 nights for runs** to be executed with La Silla telescopes. Proposals including La Silla runs with a duration of less than 3 nights will be rejected at submission time by the automatic proposal reception system, with three exceptions:
    1. There is no minimum duration for runs to be carried out with Visitor Instruments (see Sect. 8). However, in order to minimise the overheads associated with their installation on and removal from the telescope, such instruments are normally scheduled in blocks including several contiguous runs; the length of these combined blocks is typically greater than 3 nights.

2. On the NTT, users can apply for combined runs using both EFOSC-2 and SOFI. The total duration of each of these runs must be greater than or equal to three nights. The combined runs must be requested using the instrument name "SOFOSC". Details are also available in Sect. 3.2.1 and the ESOFORM Users' Manual.
3. There is no minimum duration for runs of Calibration Programmes.

Note that the minimum duration requirement for La Silla is applicable to each individual run of a proposal involving a La Silla instrument, not to the total duration of the programme, summed up over all runs (see Sect. 11 for more information about the definition of "programme" and "run"). More generally, proposals for **long** runs are strongly encouraged on the La Silla telescopes. Splitting of runs in half nights (*e.g.*, a 3-night run spread over 6 half nights) should be avoided as much as possible; such runs may not be schedulable.

– **HARPS**: A new spectropolarimetric mode for HARPS is commissioned and offered to the community in Period 86.

– In Period 86, time is available on **the 2.2-m telescope** for new proposals by general users, for observations to be executed during the slots assigned to ESO (see Sect. 4.1 for details). Proposers should take these time slots into account for the selection of the targets of their proposals. Proposals for Large Programmes will not be accepted for this telescope.

– Starting from P84 a streamlined operation model has been introduced in La Silla. While Visiting Astronomers do not have a specific support astronomer assigned on the mountain, technical and logistical support will be delivered as usual by ESO staff. Please also note that the new, reduced, transportation schedule to and from the Observatory may have an impact on the arrival and departure days of the observers at the site. See Sect. 4.1 for additional details and check the on-line instructions for **visiting astronomers**.

• **Paranal**

– **Laser Guide Star:** The experience that has now been acquired by ESO with the Laser Guide Star (LGS) shows that when it works nominally, it can be effectively used at most for 20% of the UT4 science time, due to the frequency of realisation of the required sky conditions and to intrinsic LGS operational constraints. The LGSF is offered with NACO and SINFONI in SM and VM.

Taking into account the already existing commitments for this facility (in particular, for on-going Large Programmes and for Guaranteed Time Observations), it is expected that it will be possible to allocate only a limited amount of time (less than 10 nights) in P86 to new programmes requiring the use of the LGS. Accordingly, proposers are encouraged to carry out a critical assessment of the need for LGS for execution of their observations, and to carefully study the possibility of performing them with a NGS.

– **ATs:** New baselines are offered since P85 (see **the VLTI baseline page**). Note also the new information on limitations of STRAP guiding related to the moon (see Sect. 4.2.5).

– **VLTI open for visitor instruments:** The possibility to install a Visitor Instrument at the VLTI has been offered to the community since P85.

– **CRIRES:** The installation of metrology fibers was completed in December 2009: once the corresponding control software is implemented, wavelength setting reproducibility for the standard settings will be significantly improved.

– **FLAMES-GIRAFFE:** A fast readout mode (625Khz) is offered in visitor mode only. It is not supported by the pipeline.

– **VIMOS:** As a part of a VIMOS upgrade project, ESO plans to replace the currently installed four CCDs with E2V deep depletion CCDs (similar to the ones installed in GIRAFFE). The new detectors will have a better throughput in the red and a much reduced fringing. The expected gain in QE at 900 nm is at least a factor 1.5. The intervention is expected to take place in the middle of Period 85, i.e., in the months of June and July 2010. This intervention is expected to invalidate all previous pre-imaging observations. Please consult the **VIMOS web page** for the latest news on the upgrade.

- **HAWK-I:** A Fast Photometry mode is implemented and offered starting in Period 86.
- **NACO:** The following changes take place in Period 86
  - the new visible wavefront sensor (WFS 14x14) is offered for both NGS and LGS observations;
  - cube mode without pupil tracking is offered both in SM and VM;
  - cube mode without AO (*speckle mode*) is offered both in SM and VM;
  - simple imaging (i.e. without masks or coronographs) *in pupil tracking mode* is offered in VM only;
  - the new intermediate band filter centered at 4.05μm (IB_4.05) is offered;
  - the new Apodizing Phase Plate (APP) coronograph is offered in both VM and SM and only with the NB/IB_4.05 filters
  - grism spectroscopy is offered both in Service and Visitor mode;

  Chopping remains unavailable.
- **AMBER:** Starting from P86, the standard sequence of observation is CAL-SCI-CAL.
- **VIRCAM:** VISTA starts public survey operations in P85. No open time is available in P86. For details, please refer to Sect. 6.14.
- **Latest News** on Paranal telescopes and instruments can be found at **http://www.eso.org/sci/facilities/lpo/news/**.

- **Chajnantor**
  - **SHFI:** The APEX-3 receiver covering 385 to 500 GHz is offered in Period 86 pending succesful commissioning in March 2010.
  - **FLASH:** This MPIfR PI instrument is no longer offered in Period 86 because this frequency window is covered by the APEX-3 receiver of SHFI.
  - **APEX-SZ:** This MPIfR/Berkeley PI instrument continues to be offered in Period 86 during ESO time in collaboration with the instrument team. Users should contact the instrument PI before submitting an APEX-SZ proposal.
  - **CHAMP+:** This MPIfR PI instrument is offered during ESO time in collaboration with the instrument team. Users should contact the instrument PI before submitting a CHAMP+ proposal.

- **ESO/GTC proposals**
  - In the final call for **ESO/GTC proposals**, time can be requested on the GTC instruments **CanariCam** and **OSIRIS**. These observations will be executed in either Service Mode or Visitor Mode. Only **Large Programme** proposals requesting a minimum total amount of time of 10 nights (90 hours) will be considered.

1.2 Important reminders

- **ESO User Portal:** Proposals are submitted via a web upload procedure that is accessed by logging into the ESO User Portal at: **http://www.eso.org/UserPortal**. See Sect.3 for more details.
- **Rapid Response Mode (RRM):** FORS2 on UT1, UVES and XSHOOTER on UT2, ISAAC on UT3, SINFONI and HAWK-I on UT4 continue to be offered in this mode in Period 86. RRM observations that correspond to events with exceptional characteristics may be activated during either Service Mode or Visitor Mode runs, over which they have observational priority (except if these runs involve strictly time-critical observations). For details on the RRM policies, see Sect. 11.4.1.
- **Observing mode on the VLT:** As per the VLT/VLTI Science Operations Policy, at least 40% of the available time on the VLT is reserved for Visitor Mode (VM) observations; and

Service Mode (SM) observations are scheduled for at least 50% of the available time. Departures from the observing mode requested by the proposers may be implemented by ESO so as to ensure that the intended distribution between Service Mode and Visitor Mode is achieved.

As a rule, proposers should request Service Mode only for observations that demonstrably benefit from the short-term scheduling flexibility allowed by this mode. Otherwise, Visitor Mode should be requested. Proposers who wish to do so may identify runs that lend themselves for observations in either Service or Visitor Mode by specifying one of the modes using the alternative run feature in Box 3 of the ESOFORM Phase 1 proposal form. Please note that if a certain instrument mode is offered exclusively in either Service Mode or Visitor Mode (e.g., NACO/4QPM is in VM only), then this overrides the scheduling considerations outlined above.

- **APEX:** This telescope is offered in Service Mode only. In their Phase 1 proposal APEX users:
  - must specify the requested precipitable water vapour (PWV) for their project to allow a better distinction between observations requesting a range of atmospheric transparencies;
  - should either indicate an appropriate off-source position or request time to find such a position if they wish to observe extended line-emitting regions;
  - need to merge all observations on a given APEX instrument into a single run. This also accounts for the different receivers of SHFI, which should be grouped into a single run. Different runs should only be used for different APEX instruments. For Large Programmes this restriction should be understood as a single run per instrument and per period. Different runs should be specified for observations planned to take place in different periods.
- **Duplications:** Proposers are reminded that large amounts of data are available via the ESO data archive (Sect. 2.3, see also: **http://archive.eso.org**) and they are therefore strongly advised to check if observations equivalent to the proposed ones have been performed already. Before submitting, proposers must check that their proposed observations are not duplicating **Guaranteed Time Observations approved for Period 86**.
- **Overheads:** All proposers (Service Mode and Visitor Mode) are reminded that they must include all overheads in the computation of the total observing time to be requested in their proposals (see Sect. 9).
- **Service Mode OBs:** Service Mode Observation Blocks (OBs) including all overheads can last up to a maximum of 1 hour. Longer OBs have to be specifically requested and justified at Phase 2 via a waiver request, which will be evaluated by the Observatory.
- **Access to SM data:** Principal Investigators of Service Mode programmes have access to their proprietary SM raw data as soon as the data have been ingested in the ESO Archive. Reduced data in the form of PI Packs are made available soon after the ingestion of the raw data. The data access is provided through the ESO User Portal interface.
- **Pre-imaging, Paranal:** for VLT instruments and modes for which pre-imaging is required, **a separate pre-imaging run must be specified** in the proposal (to be executed in Service Mode). Failure to do so will result in the deduction of the time necessary for the pre-imaging from the allocation destined to the main part of the project (see Sect. 13.6).
- **Pre-imaging, La Silla:** Pre-imaging frames for EFOSC-2 will have to be obtained at the beginning of the spectroscopic run itself. The resulting lower efficiency should be taken into account in the computation of the execution time required for this run.
- **Monitoring programmes:** Monitoring programmes in Service Mode are executed on a best effort basis only, *i.e.*, a monitoring sequence might be interrupted by long periods of unsuitable weather conditions or Visitor Mode scheduling.
- Although proposals requesting Visitor Mode do not need to include a backup programme, the observer must normally prepare one for the case of unfavourable weather (note in particular Sect. 4.2.7). Approval of this backup programme must be sought at least one month in advance through the change request form located at:
  http://www.eso.org/sci/observing/phase2/ProgChange/ (see Sect. 12.1).

- The information provided in the proposal is binding: all observing runs must be executed as described in the proposal. Deviations from the proposal (either by observing different targets or by using different instrument modes or different constraints) may be allowed only under exceptional circumstances and after approval by ESO (see Sect. 13.5).

1.3 Foreseen changes in the upcoming Periods

- **ISAAC** is expected to be decommissioned during 2011 to allow the installation of the second generation instrument SPHERE on UT3. Proposals for Large Programmes with ISAAC should take this limited availability of ISAAC into account. The decommissioning date is subject to SPHERE maintaining its current schedule.
- **NACO** is expected to be decommissioned by the end of 2011 to allow the installation of the second generation instrument MUSE on UT4. Proposals for Large Programmes with NACO should take this limited availability of NACO into account. The decommissioning date is subject to MUSE maintaining its current schedule.
- **SHFI:** The two Fast Fourier Transform Spectrometer units of SHFI will be upgraded to 32768 Channels, allowing to cover up to 4 GHz instantaneous bandwidth with a channel separation of 76kHz (0.1km/s). This upgraded system is expected to be available in Period 87.
- **VIRCAM:** It is foreseen that up to 15% of the available time on VIRCAM will be offered in open time in P87. For details, please refer to Sect. 6.14.
- **Visitor Instruments on VLT:** No Visitor focus will be available on the VLT starting from Period 88, when KMOS will be commissioned.
- **Spectroscopic Surveys:** Following a recommendation by the Scientific Technical Committee (STC) ESO is considering implementing Public Spectroscopic Surveys for 2011. A special call for proposals for such surveys shall be issued this year.

2 Getting Started

Observing proposals must contain a scientific case, a summary of the proposed observing programme, a list of desired instrument modes and configurations, a target list, and a precise definition of required observing conditions (seeing, atmospheric transparency, lunar illumination). In addition, a calculation of the number of hours/nights of observing time needed to accomplish the scientific goals must be carried out and summarized in the proposal. Thus it is important that proposers consult technical documentation about the capabilities and sensitivities of the instrument(s) that will be used to obtain the observations. Proposers are reminded about the existence of P2PP (Phase 2 Preparation tool) tutorials (**http://www.eso.org/sci/observing/phase2/P2PP/P2PPDocumentation.html**) and a P2PP tutorial account for all VLT instruments that can be useful in preparing Phase 1. When necessary, proposers should discuss their technical requirements with the appropriate experts (contacts provided via the ESO User Support Department, **usd-help@eso.org** for Paranal and Chajnantor, and via **lasilla@eso.org** for La Silla) before submitting their proposals. Advice about policies and about the practical aspects of proposal preparation (e.g. specification of time constraints, fulfilment of minimum run length for La Silla, etc.) should be sought from the Observing Programmes Office **opo@eso.org**.

The following subsections give some additional information and references that should be useful to proposers.

2.1 Distribution of requested Right Ascension

The distribution of the demand in Right Ascension (RA) is far from uniform throughout the year and the probability that an OPC recommended run is successfully scheduled and completed depends on this pressure. Proposers are encouraged to read the article by Alves & Lombardi (2004,

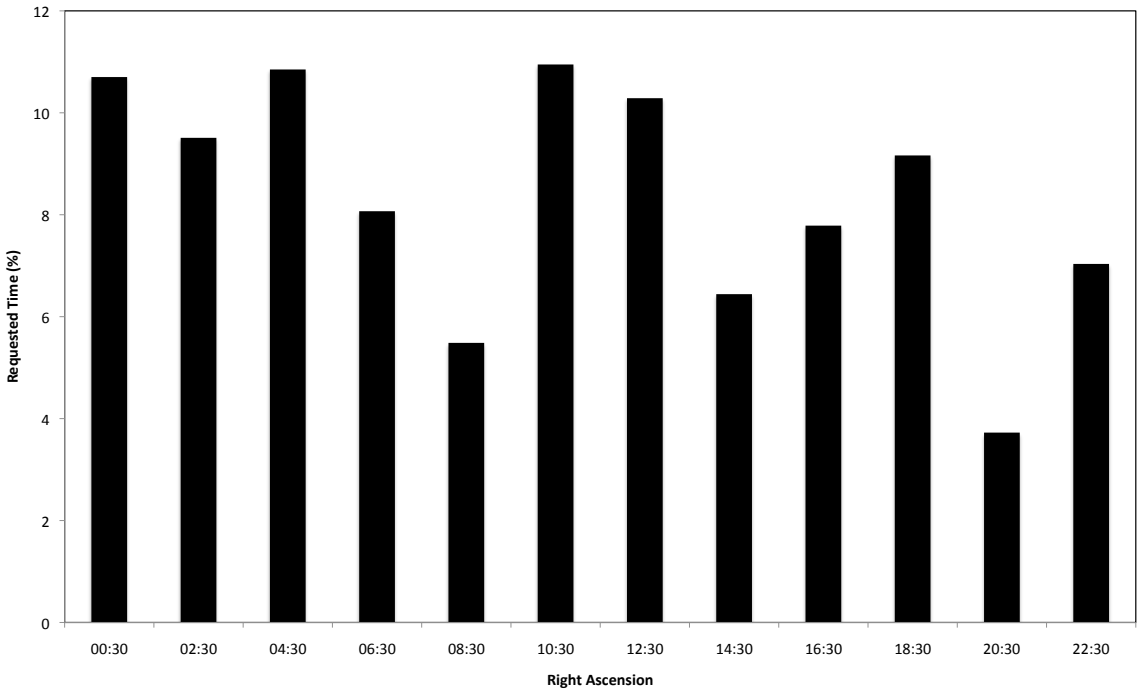

Figure 1: Distribution of requested time (percentage of total) on Paranal and La Silla as a function of Right Ascension (RA). The histogram bins have a width of 2 h and are labelled with the RA of their centre. The data for all requested targets over the last 10 periods are shown here.

The ESO Messenger, 118, 15) on the sky distribution of VLT observations. In order to optimize telescope time allocation, and to maximize the scientific return of the Observatory, proposers should be aware that choosing targets at certain RA's can have an enormous impact on the probability of successful scheduling and completion of their runs.

In this section we present statistics for previous periods. If possible, proposers should avoid the RA demand peaks discussed below.

Figures 1 and 2 highlight the fact that there is a non-uniform distribution of RA demand across the sky. For the telescope scheduler, favourite sky regions mean higher demand for observation time at certain times of the year, *i.e.*, increased competition for specific Right Ascensions. For example, there are only a limited number of photometric dark nights in April (a particularly popular demand), on average 10 times less than the total requested by observers. A direct consequence of this is that only the top OPC ranked runs make it to the telescopes during April's dark time. On the other hand, the opposite is true for January and August (see Fig. 1). The time request for targets in these months (RA $\sim$ 8h and 20h, respectively) is very low, allowing a significantly higher fraction of runs applying for time at these RAs to be scheduled (if considered useful by the OPC).

While an accurate knowledge of the distribution of favourite sky regions helps the Observatory in optimizing short- and long-term scheduling of observations and engineering activities, this optimization can only do so much when the demand for time is non-uniform. ESO observers are encouraged to take advantage of this situation and investigate if targets around RA$\sim$8h and $\sim$20h will suit their science goals.

2.1.1 Prediction of RA demand during Period 86

Based on the time request for all the ESO telescopes in the last 10 periods, one can make an educated guess of the RA demand expected during Period 86. Note that during Period 86 the distribution of instruments on the UTs will be: UT1 (CRIRES + FORS2), UT2 (FLAMES + UVES + XSHOOTER), UT3 (ISAAC + VIMOS + VISIR), UT4 (HAWK-I + NACO + SINFONI). Proposers should take advantage of this information in choosing targets to maximize the probability

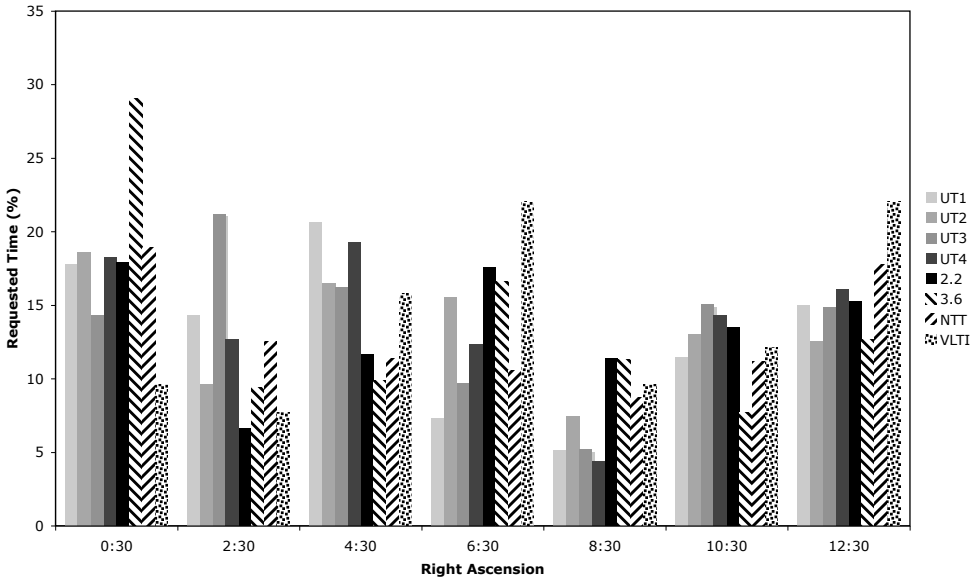

Figure 2: Prediction of RA distribution of demand during Period 86 (percentage of the total amount of time requested on the considered telescope). The RA bins are defined as for Fig. 1. The first and last bins also include the requested targets with RAs respectively earlier than the lower limit and later than the upper limit of the nominal range corresponding to the period.

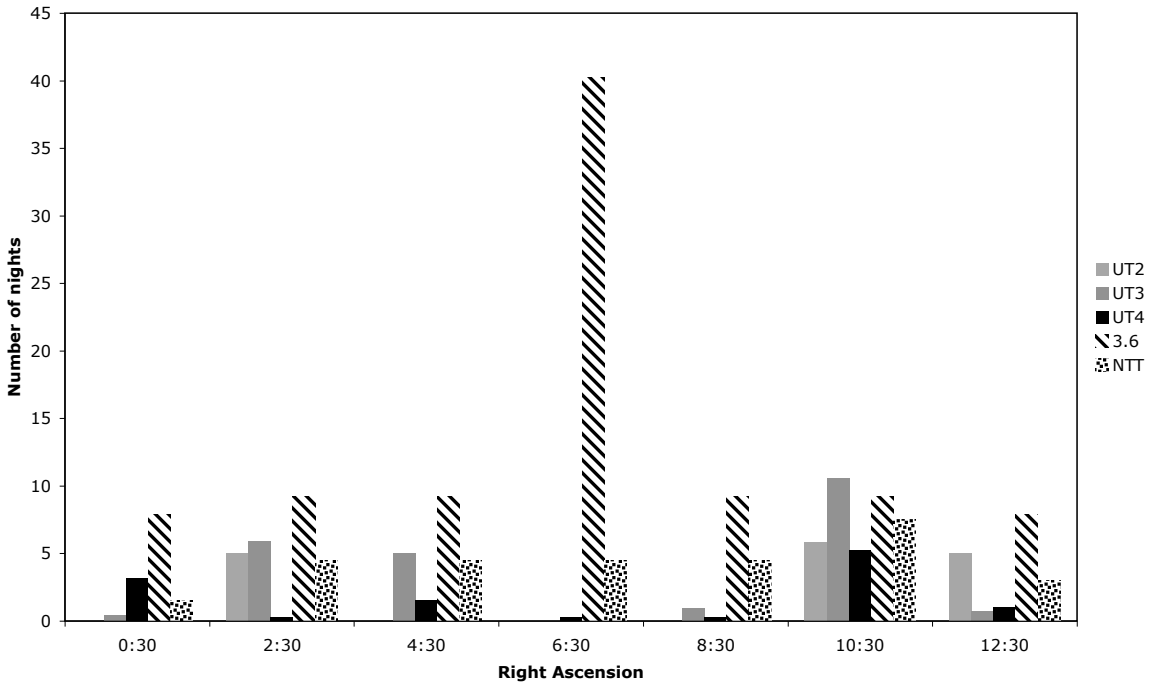

Figure 3: Expected time allocation (in nights) for ongoing Large Programmes in Period 86. The RA bins are defined as for Figs. 1 and 2.

of scheduling and completion of their runs (see Fig. 2). Proposers should also consider the time expected to be allocated in Period 86 to on-going Large Programmes started in earlier periods shown in Fig. 3. The telescopes on which no time has been allocated by on-going Large Programmes do not appear in this figure.

2.2 Exposure Time Calculators available Online

To aid proposers in calculating exposure times needed to achieve their scientific objectives, Exposure Time Calculators (ETCs) for ESO instruments are accessible directly on the ESO Web. They can be reached via:

http://www.eso.org/observing/etc

for La Silla and Paranal instrumentation. For APEX instrumentation please go to:

http://www.apex-telescope.org/instruments.

Links to useful proposal preparation software tools (*e.g.* Object Observability Calculator, Airmass Calculator, Digitized Sky Survey) can be found at:

http://www.eso.org/sci/observing/tools/index.html.

Information on standard stars and sky characteristics, as well as additional tools, are available at

http://www.eso.org/sci/facilities/paranal/sciops/tools.html.

The parameters used by the ETCs are based on data collected during instrument commissioning and operations. The ETC parameters are frequently updated and changes will be reflected by the running "version number". To help the Observatory staff assess the technical feasibility of observations, proposers are requested to specify the version number of the ETC they used in the section "`9. Justification of requested observing time and lunar phase`" of their proposals.

Please check the ESO web pages for the ETC version to be used in Period 86. Please note that while the sky background values used in the ETCs generally reflect actual conditions on Paranal accurately, they do not account for local effects such as observation in the zodiacal light.

Proposers of VLTI observations should check the feasibility of their proposed observations with the visibility calculator "viscalc", available from the ETC page. At Phase 2, users are also encouraged to select a suitable calibrator star for their planned observations using the CalVin tool, available also from **http://www.eso.org/observing/etc**.

Service Mode proposers are reminded (see Sect. 13.5) that the requested observing conditions are binding in Phase 2, hence consistency is required between the seeing constraint indicated in the first page of the proposal and the seeing value used in the ETC to estimate the observing time necessary to complete the programme. The same is true for the requested sky transparency and lunar phase. Non-photometric sky transparency can be simulated by adding 0.1/0.2 mag to the object magnitude for CLEAR/THIN–CIRRUS conditions respectively.

2.3 Online Data Products: Public Imaging Surveys, Science Verification, Advanced Data Products, etc.

Public data from observations made with Paranal and La Silla telescopes can be searched for at: **http://archive.eso.org**.

Most of the data taken in Period 84 will become available during Period 86. Users are reminded of these opportunities in order to stimulate the scientific use of the Archive and to allow a better preparation of projects for Period 86.

Several sets of reduced data products are available online at

http://archive.eso.org/cms/eso-data/data-packages.

These include Advanced Data Products (ADP) from the GOODS imaging and spectroscopic campaign or delivered to ESO by the community, data from the ESO Imaging Survey (EIS), Science Verification/Demonstration and Commissioning data of VLT and VLTI instruments. Raw images from the VISTA Public Surveys are immediately available, and advanced data products (stacked images, catalogs) will become available in incremental releases.

UVES reduced data have been ingested into the ESO Science Archive and can be retrieved using a dedicated Request Form: **http://archive.eso.org/eso/eso_archive_adp.html**.

The PIs of Large Programmes that have been accepted since Period 75 are required to deliver final data products to ESO by the time their results are published (see Sect. 11.3). The procedure to be followed is described at **http://archive.eso.org/cms/eso-data/data-submission**. An overview of ADP releases from Large Programmes is given at :
http://archive.eso.org/cms/eso-data/advanced-data-products-releases.

The PIs of Calibration Programmes are required to deliver to ESO the resulting data products within 1 year of the completion of the corresponding observations.

Voluntary submission of Advanced Data Products by PIs of Normal or Short Programmes is also encouraged. The procedure for submission to ESO of ADP from all types of programmes is the same as for Large Programmes.

3 How to submit an ESO Phase 1 proposal

3.1 How to obtain the ESOFORM Proposal Package

The ESOFORM Proposal Package for this period may be obtained by logging into the ESO User Portal. Please follow the instructions at:

http://www.eso.org/sci/observing/proposals/esoform.html

Please note that different packages should be used for the preparation of ESO proposals and ESO/GTC proposals. For ESO proposals using La Silla, Paranal or Chajnantor telescopes please use the package for **Cycle 86A**. For ESO/GTC proposals please use the package for **Cycle 86B**.

3.2 How to fill the ESOFORM Proposal Form

The "ESOFORM Users' Manual" describes in detail how to fill the LaTeX template, and which information is needed to make a proposal valid. Please be aware that the ESOFORM package is regularly updated, and that only the Period 86 package may be used for proposal preparation.

The telescope schedules are prepared using scheduling software, which relies on accurate constraints (see Alves 2005, **The ESO Messenger, 119, 20**). Hence, scheduling constraints that are not indicated or are inaccurately specified in BOX 13 of ESOFORM are unlikely to be taken into account by the scheduler. **Retrofitting scheduling constraints after the release of the schedule is often impossible.**

3.2.1 Important recent changes to ESOFORM

- **Run type** field in the `\ObservingRun` macro: It is now possible to request target of opportunity (ToO) runs in proposals for ToO, GTO[1] and DDT programmes. These programmes may include a mixture of ToO runs and "normal" runs.

  ToO runs are defined as runs for which the target cannot be known more than one week before the observation needs to be executed. Such runs will be scheduled for execution upon receipt of an activation trigger by ESO; the target (and observing time) information will be inserted by the Observatory support staff into generic Observation Blocks (OBs) submitted

[1] The possibility for GTO teams to request ToO observations as part of their guaranteed time is restricted to those cases in which this option is explicitly mentioned in the GTO contract.

by the PI at Phase 2. Targets that are unknown at Phase 1 proposal submission time but can be observed more than one week after they have been identified should be observed as part of normal (non-ToO) runs. The related OBs should be defined or updated by the PI once the target is known. The OBs should be stored in the ESO database with the complete information needed to allow them to be executed as part of the regular Service Mode queues.

In the ESOFORM, proposers must specify which runs are of ToO type by inserting the TOO flag (upper case!) in the tenth (final) field of the `\ObservingRun` macro. For non-ToO runs, this field should be left empty. ToO programmes (i.e., programmes for which the type parameter set in the ESOFORM `\ProgrammeType` macro is `TOO`) must contain at least one ToO run (for which the tenth parameter of the `\ObservingRun` macro is set to TOO). No ToO run is allowed in Normal, Short or Calibration Programmes.

- **Large Programmes:** Large Programmes can no longer be converted to Normal Programmes. Accordingly, the `\ConvertLargeToNormal` macro has been removed from ESOFORM.
- **ESO/GTC Programmes:** A special template has been developed for submission of ESO/GTC proposals. It is similar to the ESO Large Programme template, but adapted for the GTC. It is part of a separate ESOFORM package (labelled 86B), and it can be retrieved from the the same location in the ESO User Portal as the regular package (86A) for observing proposals for ESO telescopes.
- As of P85, additional flexibility is allowed for specification of the observing run duration and of the breakdown of observing runs in Box 3 of the proposal form. Details may be found in the ESOFORM Users' Manual.
- Users have the possibility to submit proposals involving observations with both EFOSC-2 and SOFI for which the amount of time requested with either of the instruments is below the 3-night minimum duration limit applicable to La Silla runs, provided that the considered EFOSC-2 and SOFI observations are to be executed on contiguous nights, and that the sum of the durations of the EFOSC-2 run and of the associated SOFI run is greater than or equal to 3 nights.

  In Box 3 of the ESOFORM proposal form, the instrument designation SOFOSC should be used to refer to the combined usage of EFOSC-2 and SOFI in a single contiguous run. The combined run must have a duration of at least 3 nights. The respective amounts of time required for observations with each of the two individual instruments must be specified in the time justification section (Box 9). Examples illustrating this new convention can be found in the ESOFORM Users' Manual. Proper usage of this convention will be enforced in P86.
- With the introduction of AT baselines for the VLTI (see **the VLTI baseline page**), detailed specification of the 2-AT (for MIDI) or 3-AT (for AMBER) baselines has been moved from Phase 1 to Phase 2. Accordingly, users should only specify the required AT quadruplets in the VLTI page of the Phase 1 proposal form.
- For encapsulated figures, version 1.4 of the pdf format is supported as of P85. More details are given in the ESOFORM Users' Manual.

If you are re-submitting a proposal **you need to address the OPC comments received on the previous submission of this proposal**.

3.2.2 Observing conditions: definitions

Observing conditions are defined as follows:

- Sky Transparency
  - Photometric: No visible clouds, transparency variations under 2%, only assessable by analysis of photometric standard stars.
  - Clear: Less than 10% of the sky (above 30 degrees elevation) covered in clouds, transparency variations under 10%.

  - Thin cirrus: transparency variations above 10%.

- Seeing
  - Seeing is defined as the image FWHM in arcsec, *at the wavelength of observation*, on the focal plane of the instrument's detector, *i.e.*, after image has been taken through the entire telescope and instrument. *It is not the instantaneous seeing outside the dome.*
  - For MACAO instruments (CRIRES, SINFONI, MIDI, AMBER), FLAMES and the IFU mode of VIMOS and in case the seeing cannot be measured on the detector, the reference seeing is the one measured at the wavefront sensor of the active optics of the telescope.
  - Phase 1 seeing constraint for observations using AO instruments should be at most 1.4″.
  - VLTI runs with MIDI that do not make use of MACAO require excellent seeing conditions. Therefore MIDI runs that do not use MACAO for more than 20% of the requested time, should indicate 0.6″ as the seeing constraint. Observations without MACAO should be carried out in Visitor Mode only.
  - AMBER observations without MACAO are not possible;
  - The seeing specified in the NAOS Preparation Software is the DIMM (Differential Image Motion Monitor) seeing corrected to zenith.
  - Use of the LGS in seeing-enhancer mode requires a seeing better than 0.8″.
- Moon
  - Moon illumination (FLI) is defined as the fraction of the lunar disk that is illuminated at local (Chile) civil midnight, where 1.0 is fully illuminated. Dark time (specified by 'd' in Box 3 of the ESOFORM package) corresponds to moon illumination < 0.4, grey time ('g') to moon illumination between 0.4 and 0.7, and bright time (specified by 'n') to moon illumination ≥ 0.7. However, in Service Mode, 'bright time' (specified by 'n' at Phase 1) is understood as meaning that no restriction is set regarding the lunar illumination (FLI=1.0 at Phase 2). By definition, moon illumination = 0 when the moon is below the local horizon.
  - Lunar illumination does not have a noticeable influence on the feasibility of infrared observations.
  - However, the UT active optics can be adversely affected by the proximity of a bright moon to the science target, requiring a moon mininum angular distance of 30°. Similar restrictions affect observations using the Auxiliary Telescopes (see Sect. 4.2.5). Observers must therefore pay attention to the moon distance to the target while planning their observations.

Naturally, seeing and moon illumination conditions are not relevant for **APEX** observations, which require an acceptable precipitable water vapour (PWV) range to be specified in mm.

Please note that observing conditions requested at Phase 1 **cannot be changed at Phase 2** (see Sect. 13.5 for more detail).

3.3 Proposal Submission

Proposals can be submitted via a web upload that can be accessed by logging into the User Portal at:

http://www.eso.org/UserPortal

prior to the submission deadline:

31 March 2010,
12:00 noon Central European Summer Time.

In order to efficiently verify and submit your proposal, please note that:

- **Postscript figures are not accepted**. The proposals are compiled using the pdfLaTeX package which accepts only PDF and JPEG file formats.
- Always compile your proposal locally with pdfLaTeX. Some of the checks are made at the LaTeX level and checking your proposal in this way will save you time. If there are errors please read the output carefully in order to identify the problem.
- Further checks are made by the web software, which uploads your proposal and checks that it complies with ESO's requirements. The receiver allows you to verify your proposal without actually submitting it. **You should take advantage of this feature to check that your proposal is technically correct well before the Phase 1 deadline.** This can be done by verifying a "skeleton" version of the proposal early; this version should contain all the technical details but not necessarily the full scientific description. This will ease the final submission process considerably.
- Plan ahead! Over past periods, congestion of the proposal submission system has repeatedly occurred in the last few hours before the proposal deadline, leading to delays in response time that occasionally exceeded 1 hour. Try to submit proposals at least one day before the deadline and avoid "last-minute stress".

At the end of the submission procedure an acknowledgment page is displayed. Please print it as a receipt. The PI of the proposal and the submitter will also receive later a confirmation ticket via email, but **the acknowledgment page is the official receipt**. If you are not sure if your proposal has successfully entered the system, **do not** re-submit it but rather contact OPO at **opo@eso.org**.

Neither proposals nor corrections to proposals that are submitted after the deadline will be considered.

Part II

ESO Telescopes and their Instrumentation

4 The Observatory

4.1 La Silla

The La Silla Observatory site is located at 70°43′ longitude West, 29°15′ latitude South, at an altitude of 2375 m. The telescopes operated by ESO are the New Technology Telescope (NTT), the ESO 3.6-m telescope, and the ESO/MPG 2.2-m telescope. Since Period 82, proposals for observations with these three telescopes are restricted to Visitor Mode runs. Each run must have a minimum duration of 3 nights. This restriction does not apply to runs using Visitor Instruments. At the NTT, for programmes involving observations with both EFOSC-2 and SOFI to be performed on contiguous nights, the minimum duration requirement applies to the combined length of the corresponding EFOSC-2 and SOFI run. The naming convention SOFOSC is used to refer to this combination – see Sect. 3.2.1 and the ESOFORM manual for more details on how to specify such combined runs in the ESOFORM proposal form.

Requests for usage of the NTT and the 3.6-m telescope for the execution of Large Programmes are particularly encouraged. As of Period 83, the maximum duration for Large Programmes with these telescopes has been increased to four years. However users should be aware of the limited possibilities of approval of new Large Programmes on the 3.6-m telescope in Periods 86 to 90, as described in Sect. 1.1. Large Programme proposals are not accepted for the 2.2-m telescope.

Starting from P84 a streamlined operation model is being introduced in La Silla. While technical and logistical support will be delivered as usual by ESO staff on the mountain, no support astronomer will in general be available on-site.

General information can be found on the La Silla web page on
http://www.eso.org/sci/facilities/lasilla/.
Proposers are also strongly advised to read the La Silla Science Operation page that provides updated information on support and procedures at
http://www.eso.org/sci/facilities/lasilla/sciops/.
The median seeing in La Silla is 0.8″ and the sky is photometric 70% of the time. For more information take a look at **La Silla weather statistics**.

- **NTT telescope:** The New Technology Telescope is an Alt-Az, 3.5-m Ritchey-Chretien telescope housed in a rotating building designed for optimized air flow. Its thin meniscus Zerodur mirror is controlled in order to maintain the optical figure so that the total aberrations are smaller than 0.15″ (80% encircled energy) — the NTT was the first telescope to be equipped with “Active Optics”. The instruments SofI and EFOSC-2 are permanently mounted at the two Nasmyth foci.

  The telescope has a pointing accuracy of 2″ RMS; objects can be observed at zenithal distances from 2° to 75°. Currently, moving targets can be observed only with differential tracking (not guiding). Moving objects can be followed for up to 15 min with a tracking error smaller than 0.5″.

- **3.6-m telescope:** The 3.6-m telescope was commissioned in 1977, and completely upgraded in 1999. Since Period 78, only the f/8 Cassegrain focus is available. In August 2004, the f/8 top end was completely replaced by a new unit permitting the secondary mirror to be actively controlled. This system provides an improved image quality. The pointing error is better than 5″ RMS. The only available facility instrument, HARPS, is permanently mounted at the Cassegrain focus. The pointing limitations are described in **the 3.6-m pages**. Full differential guiding is possible to observe moving targets.

- **2.2-m Telescope:** The 2.2-m telescope is a Ritchey-Chretien design mounted in an equatorial fork mount. It is on loan to ESO from the Max Planck Gesellschaft (MPG) and has been in

operation since 1984. In 2008, an extension of the agreement until March 31, 2013, was signed between ESO and MPG, according to which MPG is allocated 9 months of observations per year as of Period 83.

Accordingly, the preliminary breakdown of the time on the 2.2-m telescope in Period 86 is as follows (from noon of the start date to noon of the end date):

from October 1, 2010 to October 29, 2010: MPG time

from October 29, 2010 to November 20, 2010: ESO time

from November 20, 2010 to December 17, 2010: MPG time

from December 17, 2010 to December 31, 2010: ESO time

from December 31, 2010 to January 28, 2011: MPG time

from January 28, 2011 to February 19, 2011: ESO time

from February 19, 2011 to March 18, 2011: MPG time

from March 18, 2011 to April 1, 2011: ESO time

(These dates may be subject to minor changes.)

One night per month during the ESO time slots will be reserved for scheduled technical activities and execution of the calibration plan. In Period 86, ESO will be allocating approximately 66 nights for execution of scientific programmes on the 2.2-m telescope; the corresponding runs will be scheduled exclusively during the ESO time slots. Of these 66 nights, up to 18 will be allocated to Chilean proposals (see Sect. 11.9), within the framework of the guaranteed time to which Chile is entitled as host country, as per the agreement between ESO and Chile (see Sect. 13.1).

During ESO time, Visitor Mode runs may be interrupted for target-of-opportunity observations of Gamma-Ray Bursts and X-ray transient afterglows with the GROND instrument of the Max Planck Institute for Extraterrestrial Physics; up to 15% of the time allocation of each run may have to be given away to such observations. A compensation buffer of 10 nights is included in the ESO 66 nights of science time. The ESO telescope time allocation includes this compensation; users whose programmes are affected by GROND interruptions are not entitled to any additional compensation.

FEROS and WFI are permanently mounted on the telescope.

4.2 Paranal

4.2.1 The VLT UTs

The VLT consists of four Unit Telescopes (UTs). From a user's perspective the four UTs can be regarded as identical. The Paranal Observatory site is located at 70°25′ longitude West, 24°40′ latitude South, at an altitude of 2635m.

A UT main mirror is a single Zerodur blank of diameter 8.20 m, the secondary has a diameter of 1.12 m. The UTs have four foci: two Nasmyth, one Cassegrain, and one Coudé. They are Alt–Az mounted and cannot observe at zenith distances less than 4° or larger than 70°. The VLT Interferometer only operates at zenith distances less than 60°.

4.2.2 UTs Performance

- **Pointing and tracking:** The UTs have a pointing accuracy of 3″. The expected tracking accuracy under nominal wind load is 0.″1 rms over 30 minutes when field stabilization is active. The UTs also have the capability of tracking targets with additional velocities (*e.g.* Solar System targets), under full active optics control. Proposers who need this capability should specify the additional velocities in RA and Dec for their targets, for the purpose of feasibility assessment.

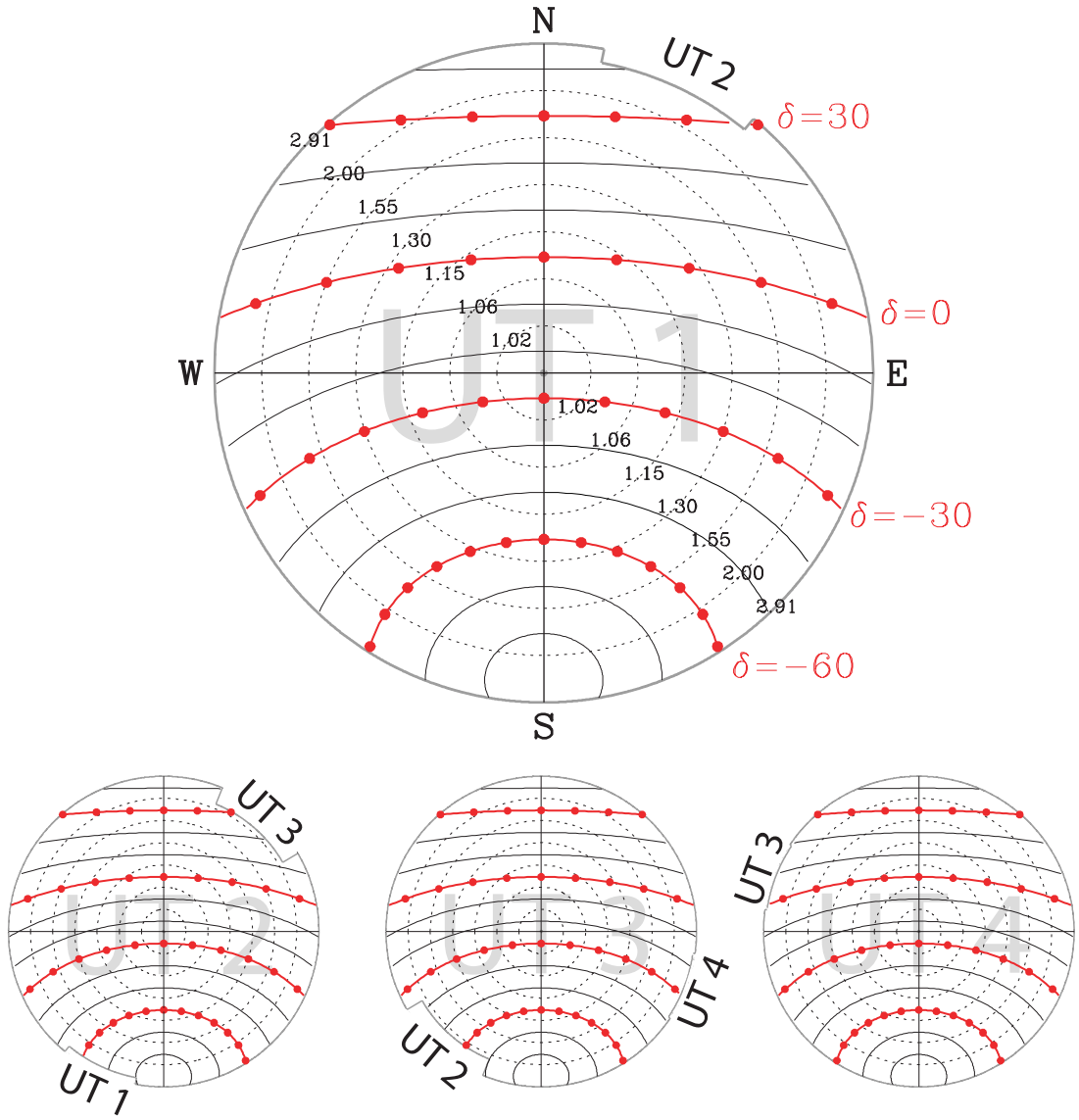

Figure 4: Sky accessibility and vignetting by neighbour for the 4 UTs. See Section 4.2.4 for more details.

- **Active optics guiding:** For all observations a guide star is used for acquisition, active optics, and field stabilization. The typical guide star magnitude ranges from R=11 to R=14 (in optimal conditions). Observations for which no suitable guide star exists cannot be carried out.
- **Adaptive optics guiding (VLTI only):** The Coude foci of the UTs are equipped with MACAO (Multi Application Curvature Adaptive Optics) units, which can be used with natural guide stars with $1 < V < 17$, seeing $< 1.4''$, $\tau_0 > 1.5$ ms and airmass < 2. The distance of the natural guide star from the science target is restricted to be within $57.5''$.

4.2.3 Laser Guide Star facility on UT4

UT4 is equipped with a sodium laser that can be used to create an artificial point source which can then be used with NACO and SINFONI. In most cases a tip-tilt star (TTS) is still necessary to correct for tip and tilt. SINFONI (since P84) and NACO (as of P85) can be used with the Laser Guide Star but without a TTS (the so-called seeing-enhancer mode). Please note that the TTS

can be both fainter and further away from the science target than natural guide stars (NGS), thus giving users access to a larger fraction of the sky.

Observations using the Laser Guide Star (LGS) require more stringent observing conditions than observations using natural guide stars. For example, the transparency needs to be clear (CLR) or better, the airmass constraints need to be tighter and the atmosphere needs to be quiet (*i.e.*, good seeing and a weak or absent jet stream). Further note that for operational reasons, the LGSF is currently scheduled in blocks of typically one week per month. As of P84, the LGSF is offered with NACO and SINFONI in Service and Visitor Mode.

The peak K-band Strehl ratio that one gets with the LGS in ideal conditions is around 20%. This depends on many factors, so users are encouraged to use the SINFONI and NACO ETCs.

The point at which one should consider using the laser instead of a natural guide star can be estimated with the ETCs. Although the details depend on the distance of the NGS/TTS from the science target, the airmass and the vertical profile of the turbulence, the magnitude at which one should consider using the laser is around R=13.5 to 14.

A programme that requires observations of a NGS, on the one hand, and the LGS, on the other hand, should be specify these as separate runs in the proposal form.

4.2.4 Paranal Sky accessibility, zones of avoidance

Figure 4 represents the sky accessibility for the 4 UTs. The outermost circle marks the telescope safety limit (zenith distance 70°). All other concentric circles come in zenith distance intervals of 10° and are marked with the corresponding airmass value. An object will move along one of the curves of constant declination. The solid dots on those curves mark the movement in 1 hour intervals, the maximum visibility period of a given object can be read directly off the figure (counting intervals between dots). The smaller plots (for UT2, UT3 and UT4) are similar, only the vignetting due to neighbouring domes vary.

4.2.5 The ATs (VLTI only)

The VLT Interferometer is complemented by an array of relocatable 1.8-m Auxiliary Telescopes (ATs). For Period 86 the ATs are offered with MIDI and AMBER. The baselines offered for P86 are available at **the VLTI baseline page**.

The ATs are equipped with STRAP units, which provide tip-tilt correction for targets with $-1.7 < V < 13.5$. The distance of the guide star from the science target is restricted to be within 57.5″.

While observations on AMBER and MIDI are not affected by the moon there are some restrictions due to the guiding of the telescopes.

- If the FLI is > 90%, guiding is not possible for stars fainter than 9th magnitude if the distance to the moon is lower than 20 degrees.
- If the FLI is > 90%, guiding is impossible for any star if the distance to the moon is lower than 10 degrees.

Visitors are requested to check for potential limitations during the preparation of their observations.

4.2.6 VISTA

The Visible and Infrared Survey Telescope for Astronomy (VISTA) is a 4-m class wide field survey telescope for the southern hemisphere. VISTA is located at ESO's Cerro Paranal Observatory in Chile on its own peak about 1.5 km from the four UTs. The telescope has an altitude-azimuth mount, and quasi-Ritchey-Chrétien optics with a fast f/1 primary mirror giving an f/3.25 focus to the instrument at Cassegrain. Shape and position of the mirrors are actively controlled by high and low order curvature wave front sensors (WFS) located inside the instrument focal plane. The low order WFSs are used simultaneously to the scientific observations.

VISTA is equipped with only one instrument, VIRCAM, described in Section 6.14.

4.2.7 Paranal meteorological conditions

Extensive statistical information on meteorological conditions on Paranal (seeing, wind, water vapour etc.) can be found on the **Paranal Web page**. Information about general climate and seismic statistics can also be found here. Wind statistics at Paranal show that the wind speed is between 12 and 15 m/s $\sim$ 10% of the time. These conditions allow observations to be made only with the telescope pointing down wind. Predominant winds blow from the North.

4.3 Chajnantor

The Llano de Chajnantor site is located on 67° 45′ longitude West, 23° 00′ latitude South, at 5104 m altitude in the Chilean Atacama desert. It is a very dry site — inhospitable to humans — but an excellent site for sub-mm astronomy (see Figure 5). Water vapour absorbs and attenuates sub-mm radiation and thus a dry site is required for high-frequency radio astronomy.

Llano de Chajnantor is one of the best sites available on Earth for sub-mm astronomy; it is also the site where ALMA is under construction — a collaboration between Europe, North America and East Asia to construct and operate a large interferometer for high sensitivity, high frequency imaging of the southern sky.

ESO has been offering time on the Atacama Pathfinder Experiment (APEX, a 12 meter radio telescope) at the Chajnantor site since Period 77. APEX is an international collaboration involving the Max-Planck-Institut für Radioastronomie (MPIfR), Onsala Space Observatory (OSO), and ESO. ESO receives 24.7% of the observing time on APEX. During Period 86, the ESO time is tentatively scheduled in August, October and December. Time-critical programmes should be scheduled during these months.

For Period 86, applications are invited for the Swedish Heterodyne Facility Instrument (SHFI), the 870 μm LABOCA bolometer array, the 350 μm SABOCA bolometer array, and in collaboration with MPIfR, the PI instruments APEX-SZ (152 GHz bolometer array) and CHAMP+ (7+7 pixel dual channel heterodyne array covering 620 to 720 GHz and 780 to 900 GHz). Observations will be done for up to 24 hours per day, but users should be aware that afternoon conditions are often significantly worse than night or morning. Observations using high frequency instruments (SHFI/APEX-T2, SHFI/APEX-3, SABOCA and CHAMP+) should avoid the afternoon time. All observations will be done in Service Mode by the local APEX staff. In exceptional cases (e.g. moving targets), remote observing from Bonn (in collaboration with MPIfR) can be considered.

No Visitor Mode proposals will be accepted. Note that due to the ongoing commissioning of the APEX instruments, the APEX schedule and instrument availability can be subject to change at short notice.

From Period 81, the **wobbling secondary** is offered on all SHFI proposals. The APEX wobbler can chop in azimuth up to 300″ with rates up to 2 Hz.

Because the LABOCA detectors need to be cooled to 0.3 K using liquid Helium, the LABOCA observations will be scheduled in continuous blocks of observing time. This will make time-critical observations during ESO time difficult to schedule. The re-filling of the Helium will generally be done during the afternoon, when weather conditions are expected to be the worst, with a shorter re-cycling procedure 11 to 12 hours later. The exact schedule will be optimised according to the LST pressure on the targets.

SABOCA also has a liquid Helium cooled cryostat, but as the hold time is 48 hours, the observations can be scheduled with more flexibility. During Period 86, SABOCA is expected to be available only in August and October.

All APEX proposals should clearly indicate the requested PWV for their observations in Box 12 of the proposal form. Figure 5 gives the statistical distribution of PWV throughout the year.

For each proposal, all observations with the same APEX instrument should be merged in a single

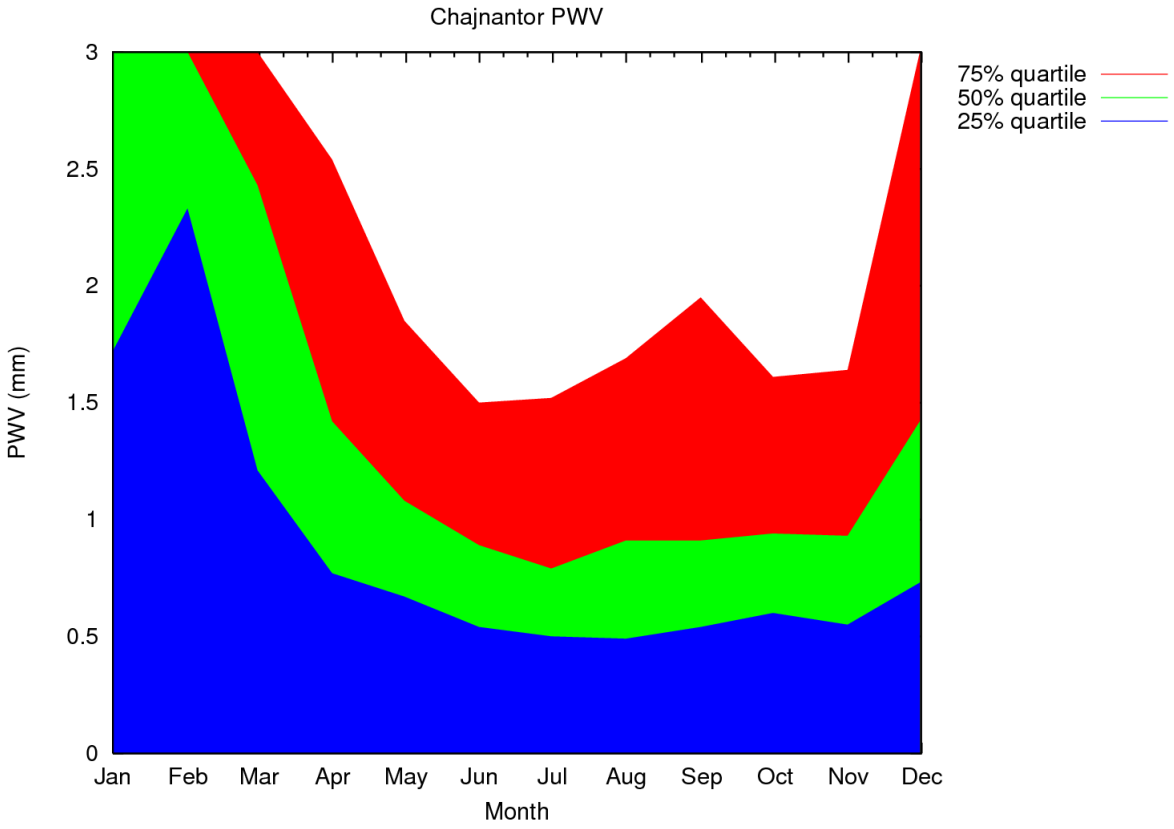

Figure 5: Annual variation of the Precipitable Water Vapour (PWV) content at Chajnantor, based on 10 years of site testing. During Period 86, observations will only be scheduled from August to December, when median conditions are expect to be around PWV $\sim 1\,\mathrm{mm}$.

run. This also accounts for the different receivers of SHFI, which should be grouped into a single run. Different run ID's should only be used for different instruments (or in Large Programme proposals, for observations to take place in different periods). This restriction is needed to increase the observing efficiency at APEX.

More on APEX, including SHFI, LABOCA and SABOCA observing time calculators can be found at **www.apex-telescope.org.**

5 Scientific Instruments: La Silla

5.1 SofI — Son of ISAAC, on the NTT

SofI is the infrared spectro-imager mounted on the NTT and has the following observing modes:

- Imaging with plate-scales of 0.273 and 0.288″/pixel using broad and narrow-band filters in the wavelength range 0.9–2.5 μm. SofI provides a field of view of 4.92′. As of Period 80, the imaging modes with 0.144″/pixel plate-scales, *i.e.*, the small field objective and the large field plus focal elongator, are no longer offered. A Js filter similar to that on ISAAC is available in addition to the standard J filter.
- High time-resolution imaging in Burst and FastPhot mode with integration times of the order of a few tens of milliseconds via hardware windowing of the detector array. Information about technical details, restrictions, and overheads is available in the **SofI user manual**.
- Low resolution ($R = 600$), 0.93–2.54 μm spectroscopy with fixed width slits of 0.6, 1 and 2″.
- Medium resolution ($R = 1500$) spectroscopy with the same fixed width slits.
- 0.9–2.5 micron imaging polarimetry.

SofI is equipped with a Hawaii HgCdTe 1024×1024 detector. Up-to-date information and documentation on the instrument are available at:
http://www.eso.org/sci/facilities/lasilla/instruments/sofi/.

SofI is only operated in Visitor Mode.

5.2 EFOSC-2 — ESO Faint Object Spectrograph and Camera 2, on the NTT

EFOSC-2, is a very versatile instrument for low resolution spectroscopy and imaging in the visible and near UV. It also has polarimetric capabilities (both for imaging and spectroscopy) and a coronagraphic mode, and it can efficiently perform Multi-Object Spectroscopy.

The instrument is equipped with a Loral/Lesser UV-flooded 2k×2k CCD. The pixel size is 0.12″, with a corresponding field of view of 4.1′.

The traditional grisms cover the 318–1100 nm wavelength range, with resolutions ranging from 100 to 1000. Slits from 0.5″ to 15″ are available.

Since P81, two volume-phase holographic grisms (VPHG) have been offered for medium resolution spectroscopy. The blue grism (#19) covers the wavelength range from 440 nm to 510 nm, at a resolution of up to $\sim$ 4000 with a 0.5″ slit, while the red grism (#20) covers the range 605 nm to 715 nm at a resolution of up to 4000 with the 0.5″ slit. The grisms introduce a lateral shift of the beam, so the effective field of view is 3.1′ and 2.7′ for the blue and red VPHGs respectively.

The wavelength range of the blue VPHG grism (#19) can be extended to cover a more useful range (e.g., reaching the Mg triplet at 520 nm or the G-band at 430 nm) by using slits offset to the red or blue. With 15 mm offsets (corresponding to wavelength offsets of 21.8 nm) the wavelength range coverage for the grism #19 is 418 nm to 532 nm (the full range is achievable by combining red offset and blue offset spectra). There are offset slits available with 15mm offsets to the blue and red with

the full range of slit widths available for the normal slits. These slits can of course be used with any other grism, with the wavelength offset depending on the grism dispersion. See the web pages for more details.

Up to 5 MOS plates can be loaded simultaneously. They are punched off-line, so additional plates can be punched at any time. To create multi-slit masks, pre-imaging must be acquired using EFOSC-2 with the same position angle as for the actual observations, typically one day before the spectroscopic observations. Therefore, NTT observers in La Silla may be asked to give up to 20 minutes of their allocated time for pre-imaging observations for subsequent EFOSC2 MOS runs.

The coronagraphic mode features focal stops of 8.0″ and 4.0″ and a Lyot pupil mask.

The polarimetric measurements are performed using either a half-wave plate or a quarter-wave plate. These super-achromatic plates can be moved into the optical path and rotated to measure the polarisation at different angles without rotating the whole instrument. The plates are housed in separate units, and only one unit (plate) per night can be used. Note that since EFOSC-2 is now mounted at the NTT Nasmyth B focus there is strong instrumental polarisation that varies with telescope pointing. Users should allow time for additional observations of unpolarised standard stars to correct for this.

For imaging, a set of standard Bessell and Gunn filters as well as several narrow-band filters are available. See **the EFOSC-2 filter page** for details. Up-to-date information and documentation on the instrument are available on the **EFOSC-2 web page**.

Since Period 84, EFOSC-2 is mounted on the NTT and only operated in Visitor Mode. Information about the characterisation of the instrument at the new focal station and telescope is available on the web pages.

5.3 HARPS — High Accuracy Radial velocity Planetary Search, on the 3.6-m

HARPS is the ESO facility for the measurement of very precise radial velocities. It is fed by two fibres from the Cassegrain focus of the 3.6-m telescope.

The instrument is built to obtain very precise radial velocities (on the order of 1 m/s). To achieve this goal, HARPS is designed as an échelle spectrograph fed by a pair of fibres and is contained in a vacuum vessel to avoid spectral drift due to temperature and air pressure variations. One of the two fibres collects the starlight, while the second is used to either record a Th-Ar reference spectrum or the background sky simultaneously. The two HARPS fibres (object + sky or Th-Ar) have a sky aperture of 1″, resulting in a resolving power of 115,000. Both fibres are equipped with an image scrambler to provide a uniform spectrograph pupil illumination, independent of pointing decentring. The spectral coverage distributed over the échelle orders 89-161 is 378 nm–691 nm. As the detector consists of a mosaic of 2 CCDs (altogether 4k×4k, 15 μm pixels), one spectral order (N=115, from 530 to 533nm) is lost in the gap between the two chips.

HARPS reaches a signal-to-noise ratio of 110 per pixel at 550 nm for a $M_V = 6$ G2V star in 1 minute (1″ seeing, airmass = 1.2). When using the Simultaneous Thorium Reference Method, which is the mode for achieving the highest radial velocity accuracy, this signal-to-noise ratio should be sufficient to achieve a photon-noise-dominated radial velocity accuracy of about 0.90 m/s. Taking into account errors introduced by the guiding, focus, and instrumental uncertainties, a global radial velocity accuracy of about 1 m/s RMS is achieved. This is obtained for spectral types later than G and for non-rotating stars ($v \sin i < 2$ km/s).

In simultaneous Th-Ar mode, HARPS users should strictly follow the calibrations foreseen by the Calibration Plan, which includes a number of biases, flatfields and Th-Ar exposures taken before the night.

HARPS is equipped with its own pipeline (installed on La Silla). This pipeline provides the visiting astronomer with extracted and wavelength calibrated spectra in near real-time (in all observing modes). When the Simultaneous Thorium Reference Method is applied, the pipeline delivers precise radial velocities (RV, relative to the solar system barycentre) for late-type stars whose RV is known within 1–2 km/s, provided that a set of standard calibrations has been executed in the afternoon.

An additional fibre, with a larger aperture (1.4″ on the sky) is available for HARPS. This high efficiency mode is dubbed "EGGS". The higher efficiency compared to the base mode (referred to as "HAM") is achieved by reducing flux losses through the larger fibre aperture and by dispensing the image scrambler. The resolving power of the mode, due to the larger fibre, decreases to about 80 000. This mode is particularly useful for faint objects. Its peak efficiency is 11% and the gain in flux with respect to the HARPS base mode is 75% at 530 nm with a seeing of 0.8″. This mode is now equipped with only one fibre, therefore neither the sky subtraction, nor the simultaneous Thorium reference method can be applied. However the intrinsic instrument stability (better than 1 m/s) is much superior to the EGGS radial velocity accuracy. The achievable radial velocity accuracy of the EGGS mode is limited by systematics and is of the order of 10 m/s RMS. The amount of diffuse light in the spectrograph is of the order of 4%.

The EGGS mode is also supported by a full reduction pipeline running at the telescope. Both raw and reduced data will be delivered to the user. The HARPS baseline mode and the high efficiency mode can be both used on the same night . The time needed to switch from one mode to the other is of the order of 1 minute. For radial velocity measurements a calibration sequence similar to that of the base mode should be used.

Starting from Period 86 a polarimeter is available on HARPS. The unit is able to perform both circular and linear polarimetry. Preliminary measurements of the throughput indicate a light loss with respect to the base mode of HARPS in the range of 20% to 30%, increasing to $\approx$ 40% in the bluest orders. Instrumental polarization is not detected down to a level of 10^{-4} for zenith angles smaller than 60 degrees. Closer to the horizon instrumental polarization grows rapidly if the Atmospheric Dispersion Corrector is in the light beam. HARPS polarimetric data are reduced by the online pipeline.

HARPS will be offered only in Visitor Mode during Period 86.

The user manual and exposure time calculator are available through the HARPS web page at **http://www.eso.org/sci/facilities/lasilla/instruments/harps/index.html**.

5.4 FEROS — Fibre-fed Extended Range Optical Spectrograph, on the 2.2-m

FEROS is ESO's high-resolution, high-efficiency spectrograph on the 2.2-m telescope. It is a bench-mounted, thermally controlled, prism-cross-dispersed échelle spectrograph, providing, in a single spectrogram spread over 39 orders, almost complete[2] spectral coverage from $\sim$ 350 to $\sim$ 920 nm at a resolution of 48 000.

The spectrograph is fed by two fibres, allowing simultaneous spectra of an object and either the sky or a calibration source (normally a wavelength calibration lamp). The fibres are illuminated via apertures of 2.″0 and are separated by 2.′9.

The mechanical and thermal stability of FEROS is such that the wavelength calibration obtained during the day is sufficiently accurate for most purposes. Additional night-time calibrations are not necessary. Although not intended as a 'radial velocity machine', precise radial velocity work (accuracies of $\sim$ 25 m/s or better) is possible, especially via the Object-Calibration mode.

A dedicated pipeline provides, in almost real time, extracted 1-dimensional, wavelength calibrated spectra, which can be used as a preview and to check S/N. The core of the FEROS pipeline is included in the standard MIDAS distribution and, together with the FEROS-DRS package (provided at the **FEROS web site**), can be used to re-reduce the data to obtain publication quality results.

A new atmospheric dispersion corrector (ADC) was installed in March 2006, correcting the loss of transmission in the previous ADC. It dramatically decreases the loss of light injected into the fibre when observing at airmasses greater than 1.3.

During Period 86, FEROS will be offered only in Visitor Mode. The available ESO time-slots at the 2.2-m telescope, as defined in Sect. 4.1, need to be taken into account for proposal preparation.

Further details can be found in the FEROS web pages.

[2] The two spectral ranges 853.4–854.1 nm and 886.2–887.5 nm are lost due to non-overlap of the spectral orders.

5.5 WFI — Wide Field Imager, on the 2.2-m

The Wide Field Imager (WFI) has a field of view of $34' \times 33'$ and is composed of a mosaic of 4×2 CCD detectors with a pixel size of $0.24''$and narrow inter-chip gaps, yielding a filling factor of 95.9%. It offers excellent sensitivity from the atmospheric UV cut-off to the near IR.

The filter storage and exchange mechanism, with 50 positions, accommodates 11 broad-band filters (including a fully transparent one), 27 medium-band filters covering the whole wavelength range, and 8 narrow-band filters centred at [OIII], [SII], Hα and a few other wavelengths. The large number of medium- and narrow-band filters are specifically selected to support the determination of photometric redshifts of distant objects.

We summarise the performance of WFI below. The table should only be used as a quick guide of feasibility. Proposers should refer to the detailed information that is available via
http://www.eso.org/sci/facilities/lasilla/instruments/wfi/index.html.

Table 1: WFI limiting magnitudes

Filter	Limiting magnitude (S/N=5)
U	23.8
B	26.0
V	25.5
R	25.3
I	24.3

The limiting magnitudes correspond to a one-hour integration with dark sky, clear conditions, a seeing FWHM of $0.''8$ and an airmass of 1.2, and have been calculated for a point source of zero colour (A0V star). To estimate the operational overheads of your proposed observations, please consult Chapter 5.1. of the **WFI handbook**. Note that for dithering offsets larger than $150''$, the overhead increases by 1 minute per offset. These extra overheads must be properly accounted for.

As of Period 82, WFI is offered only in Visitor Mode. All applicants are invited to take into account the availability restrictions of the 2.2-m during ESO time and the corresponding lunar phases (see Sect. 4.1).

6 Scientific Instruments: Paranal

6.1 CRIRES, Cryogenic high-resolution IR Échelle Spectrograph

CRIRES is the infrared (0.95 μm – 5.4 μm) high–resolution spectrograph located at the Nasmyth A focus of UT1. It provides long–slit ($39''$) spectroscopy with a spatial sampling of $\approx 0.1''$. Spatial resolution and signal–to–noise ratio can be maximized by the optional use of a MACAO adaptive optics system equipped with an optical (R band) wavefront sensor. Good correction is still obtained with stars as faint as R$\sim$ 14 mag under average seeing conditions, while moderate image quality improvement is seen with stars as faint as R$\sim$16-17 mag under good seeing (FWHM $< 0.6''$) conditions.

The main optical elements consist of a prism acting as a pre–disperser and a 31.6 lines/mm échelle grating. Total spectral coverage per individual wavelength setting is $\sim \lambda/70$ thanks to an array of four 1024 x 512 Aladdin III detectors. Acquisition and guiding are performed by the means of a slit viewer equipped with an additional, recently replaced, Aladdin III detector and a series of five filters (J,H,K and two neutral density H filters).

The recommended minimum slit width is $0.2''$, providing a resolving power up to $R \simeq 100,000$. A resolution of $R \sim 50,000$ can be reached with a $0.4''$ slit width. Standard and free wavelength settings are offered for both Visitor Mode (Sect. 12.1) and Service Mode (Sect. 12.2). For settings shortward of $\sim 3\mu$m, the blue and red ends of the wavelength coverage can be affected by contamination from adjacent orders and lack of illumination reproducibility. Tables 4 and 5 of the User Manual report the spectral range free of these effects for all standard settings.

Despite the availability of a Krypton and ThAr lamps and of the N_2O and CO gas-cells, the lack of wavelength calibration lines still affect some settings.

Provided an adequate observational strategy is followed, radial velocity measurements to better than ≈ 30m s^{-1} can be reached for stars showing a sufficient number of spectral features.

For the latest information on the instrument, please consult **the CRIRES web pages**.

Table 2: Point source sensitivities determined using a 0.4″ slit, adaptive optics, optical seeing of 0.8″ and nodding along the slit. The values listed correspond to a S/N of 10 for a 1 h on–source integration in one spectral dispersion element. They are obtained by integrating the spectrum profile along the spatial direction.

Band	Sensitivity (mJy)	Magnitude
J	1.1	15.4
H	1.1	15.1
K	1.1	14.6
L	9.5	11.2
M	26	9.4

6.1.1 Calibration

The observer has to supply his/her own standard star calibration OBs to correct for telluric features. In particular for Service Mode observations, OBs are typically executed in one-hour blocks; therefore, a telluric OB should be supplied for each science OB in order to achieve a proper correction. High-precision wavelength calibration or flat-fielding requires an attached template. The observing time needed to execute these calibrations is charged to the observer.

The Observatory provides day-time calibrations such as lamp flats and wavelength calibrations with the same wavelength settings as those used for the science, as well as darks obtained with the same detector settings as the science and telluric observations, lamp flats and wavelength calibration frames. Note however, that day-time wavelength calibrations are only provided for $\lambda < 2.4\mu$m, as calibrations based on sky lines are in any case better for redder wavelengths.

6.1.2 Sensitivity

Table 2 lists the offered sensitivities. This table is only intended to be a quick feasibility guide.

Proposers should refer to the Exposure Time Calculator at **http://www.eso.org/observing/etc/** to assess the feasibility of their programmes. Detailed information regarding CRIRES is provided in the Users' Manual, available via **the CRIRES web pages**.

6.2 FORS2, Focal Reducer/low dispersion Spectrograph 2

FORS2 is a multi-mode optical instrument placed at the UT1 Cassegrain focus. It is capable of imaging, polarimetry, long slit and multi-object spectroscopy. Following the merging of the two FORS instruments at the beginning of P83, it has two detector systems and a wide range of exchangeable optical elements.

The default MIT detector consists of a mosaic of two 2k×4k MIT CCDs (15 μm pixels) and is available for Service and Visitor Mode observations. A blue-optimized E2V mosaic is available **only for Visitor Mode observations**. Compared to the E2V detector, the MIT mosaic provides greatly improved red sensitivity (> 750 nm) with very low fringing. However, the response of the MIT detector below 600 nm is reduced. The detector systems are not mounted at the same time, hence the use of the E2V detector is limited to Visitor Mode and must be justified in the Phase 1

proposal.

Whether the MIT or E2V detector are required must be explicitly requested in Box 14 by uncommenting the corresponding instrument configuration line. This will ensure smooth operations by flagging the detector change in the schedule.

The image scale in the default readout mode (2 by 2 binning) is $0\farcs125$/pixel in the high resolution (HR) mode and $0\farcs25$/pixel in the standard resolution (SR) mode. The field of view in these two modes is, respectively, $4\farcm25 \times 4\farcm25$ and $6\farcm8 \times 6\farcm8$ (note that the detector area is larger than the field of view). The different magnifications are chosen by setting one of the two collimators. Hence, each magnification has to be calibrated independently. Unbinned CCD readout modes are only offered for applications that specifically require them; the use of unbinned modes must be explicitly requested in the proposal.

In addition to the standard imaging and longslit spectroscopy modes, some of the key capabilities of FORS2 are listed below.

6.2.1 Multi-object Spectroscopy

FORS2 provides two multi-object spectroscopy modes. The MOS mode comprises 19 movable slitlets of fixed slit lengths between $19''$ and $21''$ and user-selectable slit widths. The MXU mode provides the possibility to insert a mask in the focal plane, in which slits of different lengths, widths and shapes can be cut with a dedicated laser cutting machine. The FIMS tool (Sect. 6.2.6) must be used for Phase 2 preparation of MOS and MXU observations. The performance of the MOS and MXU modes are equivalent (cf. Table 4). Both modes are only offered with the standard resolution collimator.

6.2.2 High throughput filters

A set of high throughput filters are used on FORS2 to maximize the sensitivity below 600 nm.

6.2.3 Volume-phased holographic grisms

In addition to the standard low-resolution grisms, a number of high throughput VPH grisms are available which are optimised for both the MIT and E2V detectors.

6.2.4 Polarimetry

FORS2 is capable of measuring both linear and circular polarisation for direct imaging and spectroscopy. It uses a Wollaston prism as the beam splitting analyser and two superachromatic phase retarder plate mosaics located in the parallel beam.

6.2.5 High Time Resolution mode

The High Time resolution (HIT) mode is available with FORS2 (currently only with the MIT detector) in imaging (Visitor and Service Modes) and spectroscopy (Visitor Mode only) with a range of filters for imaging and the 600B and 300I grisms for spectroscopy.

In the one-shift mode, the times for a full shift across the mosaic are 1, 4, 16, 64, 256 sec, providing time resolutions for $1''$ on sky from 2.3 msec to 0.6 sec. The multiple-shift (MS) mode is predominantly implemented for fast spectroscopy and allows a block of rows to be shifted together. In MS mode, two user-defined slits can be used; these place the spectra of the target and a comparison star onto a small region of the CCD. After a pre-defined 'wait' time (0.1–20 secs), the rows of the CCD are rapidly shifted (50 microsec), causing the exposed region to be moved into the 'storage area' (the unexposed region) of the CCD and a new region to be illuminated. This 'shift and wait' scheme continues until the first pair of spectra taken reach the limit of the storage region and the CCD is subsequently read-out in the normal way allowing 41 pairs of spectra per CCD readout.

We summarise the operational modes and performance of FORS2 in the two tables below. These tables are only intended to be quick feasibility guides. Proposers should refer to the detailed information (e.g. Users' Manual, Exposure Time Calculator) available via **the FORS web pages**.

Table 3: Offered FORS2 imaging modes for Period 86

Instrument Mode	Magnitude limit (S/N=5)
Direct Imaging (MIT)	U=24.8 B=27.3 V=27.1 R=26.7 I=25.7 z=24.7
Direct Imaging (E2V)	U=25.9 B=27.6 V=27.3 R=26.7 I=25.7
HIT Imaging (MIT)	U=16.0 B=19.5 V=20.0 R=20.3 I=19.5

The magnitude limits in Table 3 correspond to a one hour integration with dark sky, clear conditions, a seeing FWHM of 0.″8 and an airmass of 1.2, and have been calculated for a point source of zero colour (A0V star). The U, B and V magnitude limits are calculated using the new high throughput filters. The values are shown for both the standard MIT detector mosaic, as well as the E2V mosaic which is available for Visitor Mode observations.

Table 4: Offered FORS2 spectroscopic modes for Period 86

Instrument Mode	Rs = $\lambda/\Delta\lambda$	Magnitude limit
E2V		
MOS – movable slits[1]	260–1700	R = 24.0–22.8
Long slit Spectroscopy[2]	260–1700	R = 24.0–22.8
Spectropolarimetry[3]	260–1700	R = 19.2–17.2
MIT		
MOS – movable slits[1]	260–2600	R = 24.2–23.3
MXU – exchangeable masks[2]	260–2600	R = 24.2–23.3
Long slit Spectroscopy[3]	260–2600	R = 24.2–23.3
HIT-MS spectroscopy	660–780	R = 19.5–12.3
HIT-OS spectroscopy[4]	660–780	R = 14.3

[1] In multi-object spectroscopy one may have 19 slitlets of length alternating between 20″ and 22″.

[2] Only offered with the SR collimator.

[3] In long slit spectroscopy the slit is chosen out of a set of 9 slits with fixed width between 0.″3 and 2.″5.

[4] In HIT-OS mode slit masks with widths between 0.5″ and 5.0″ are available.

The magnitude limits given in Table 4 are the R-band magnitudes of a point source of zero colour that would result in a S/N of 5 per pixel at 650 nm (grisms 150I and 600RI) in the continuum in a one-hour integration with dark sky, clear conditions, a seeing FWHM of 0.″8, an airmass of 1.2, and using the 1.″0 slit and the SR-collimator. The two limits given are for the two representative resolutions. In the case of the HIT-MS mode, the two limits represent the slowest and fastest readout modes available. In the case of the HIT-OS mode it is simply the limiting magnitude for the slowest mode available (HIT-OS5-256sec).

6.2.6 FORS Instrumental Mask Simulator (FIMS)

To prepare precise target acquisitions during Phase 2, ESO provides the FIMS software tool. Usage of FIMS is required when using several spectroscopic modes, as well as to prepare occulting bar imaging and spectropolarimetric observations. Phase 1 proposers who wish to justify their time request by optimising movable or MXU slitlet positions during Phase 1 may find it useful to download and install FIMS. Please refer to:
http://www.eso.org/sci/observing/phase2/FORS/FIMS.html
for instructions on how to install FIMS and to the **FIMS Users' Manual** on how to use FIMS. Users are reminded that only the FIMS version specifically assigned to a given period may be used. Older versions should never be used as they may not contain the correct FORS set-up.

6.2.7 Accurate Astrometry or Pre-imaging Required

Highly accurate relative astrometry is required for any observing mode that makes use of FIMS or does blind offsets during the acquisition. The mask preparation with FIMS requires input images that are astrometrically corrected within the definitions and precision given below. DSS images will, in almost all cases, **not** be suitable for the task.

In general the relative astrometry must be known to better than $^1/_6$ of the slit width over the entire field of view. Relative astrometry here means that the slit positions must be known relative to those of the reference stars in the field of view with the given precision. These relative astrometric calibrations are fulfilled if your FIMS preparation is based on images taken with FORS1 after March 22, 2003 or on any FORS2 images.

An important exception is multi-object spectroscopy with unbinned CCD readout modes: users wishing to apply for this mode must request additional pre-imaging, even if previous FORS1 or FORS2 images are available.

If images of adequate quality are not available, Phase 1 proposers **must** apply for pre-imaging defined as a separate run in the Phase 1 proposal and clearly marked as pre-imaging (PRE-IMG) in the "Instrument configuration" section of the proposal. Failure to do so will result in the deduction of the pre-imaging time from the time allocation assigned to the main project, if the programme is approved for execution. As a rule, pre-imaging runs are carried out in Service Mode, even for programmes whose main (spectroscopic) runs are conducted in Visitor Mode.

For further information, FORS2 proposers should visit the **FORS web page**.

6.3 FLAMES, Fibre Large Array Multi-Element Spectrograph

FLAMES is the multi-object, intermediate and high resolution spectrograph of the VLT. Mounted at the Nasmyth A platform of UT2, FLAMES can access targets over a large corrected field of view (25′ diameter). It consists of three main components:

- A **Fibre Positioner** (OzPoz) hosting two plates: while one plate is observing, the other positions the fibres for the subsequent observations, therefore limiting the dead time between one observation and the next to less than 15 minutes, including the telescope preset and the acquisition of the next field.
- A medium-high resolution optical spectrograph, **GIRAFFE**, with three types of feeding fibre systems : **MEDUSA, IFU, ARGUS**.
- A link to the **UVES spectrograph** (Red Arm) via 8 single fibres of 1″ entrance aperture.

Special observing software (**FLAMES OS**) coordinates the operation of the different subsystems, also allowing simultaneous acquisition of UVES and GIRAFFE observations with the observing modes listed in Table 5. For combined observations, the exposure times for UVES and GIRAFFE do not need to be the same. Note that it is not possible to observe simultaneously in two GIRAFFE modes, or to observe the same target simultaneously with the two spectrographs.

6.3.1 Instrument Capabilities

GIRAFFE is a medium-high ($R = 5,600$–$48,000$) resolution spectrograph for the entire visible range, 370–950 nm. It is equipped with two gratings and several filters are available to select the required spectral range. Five additional fibres allow simultaneous wavelength calibration of every exposure. Each object can be observed in only one, or a fraction of, a single échelle order at once. The fibre system feeding GIRAFFE consists of the following components:

- Two **MEDUSA** slits, one per positioner plate: up to 132 separate objects (including sky fibres) are accessible in MEDUSA single fibre mode, each with an aperture of 1.″2 on the sky.

Table 5: FLAMES Observational Capabilities

Spectro.	Mode	N. Objects	Aperture [″]	R*	Cover.	Comments
UVES6/8	RED	6 or 8 (with sky)	1.0	47000	200	6 fib@520nm
UVES7+1	RED	7 (with sky)	1.0	47000	200	+Sim.Calib.
GIRAF HR	MEDUSA	131[a] (with sky)	1.2	21000[1]	λ /22 – λ/12	
GIRAF LR	MEDUSA	131[2] (with sky)	1.2	7000[1]	λ /7.5	
GIRAF HR	IFU	15 (+15 sky)	2×3	32000[1]	λ /22 – λ/12	
GIRAF LR	IFU	15 (+15 sky)	2×3	11000[1]	λ /7.5	
GIRAF HR	ARGUS	1	11.5×7.3 or 6.6×4.2	32000[1]	λ /22 – λ/12	
GIRAF LR	ARGUS	1	11.5×7.3 or 6.6×4.2	11000[1]	λ /7.5	

[1] The resolving powers (R) given here are only average values, for more details see http://www.eso.org/sci/facilities/paranal/instruments/flames/doc/ which contains a description of all the GIRAFFE setups.

[2] The number of allocable buttons is 132, but only 131 spectra are fully covered on the detector.

- Two **IFU** slits: each IFU (deployable Integral Field Unit) consists of a rectangular array of 20 microlenses of 0.″52 each, giving an aperture of 2″×3″. For each plate there are 15 IFU units dedicated to objects and another 15 dedicated to sky measurements. In the latter, only the central fibre is present.
- One **ARGUS** slit: the large integral field unit ARGUS is mounted at the centre of one plate of the fibre positioner and consists of a rectangular array of 22 × 14 microlenses. Two magnification scales are available: "1:1" with a sampling of 0.″52/microlens and a total aperture of 11.″5×7.″3, and "1:1.67" with 0.″3/microlens and a total aperture of 6.″6×4.″2. In addition, 15 ARGUS sky fibres can be positioned in the 25′ field.

GIRAFFE is equipped with one 2k×4k EEV CCD (15 μm pixels), with a scale of 0.″3/pixel in MEDUSA, IFUs and ARGUS direct mode, and a scale of 0.″15/pixel in the enlarged ARGUS mode. GIRAFFE is operated with 39 fixed setups (31 high resolution + 8 low resolution modes).

The standard readout mode of FLAMES-GIRAFFE is 225 kHz (unbinned) which ensures low readout noise. Starting from Period 86, a high-speed readout mode (625 kHz, unbinned, low gain) with increased readout noise but less overheads is offered in Visitor Mode only. No pipeline support is available for this mode.

UVES is the high resolution spectrograph at UT2 of the VLT (see Sect. 6.4). It was designed to work in long slit mode but it has been possible to add a fibre mode (6 to 8 fibres, depending on setup and/or mode) fed by the FLAMES positioner to its Red Arm only. Only three of the standard UVES Red setups are offered, with central wavelength of 520, 580 and 860 nm respectively (see **the UVES Users' Manual** for details).

The standard readout mode of FLAMES-UVES is 225 kHz (unbinned) which ensures low readout noise. Since Period 76, a high-speed readout mode (625 kHz, unbinned, low gain) with increased readout noise but less overheads has been offered in Visitor Mode only. No pipeline support is available for this mode.

With an aperture on the sky of 1″, the fibres project onto 5 UVES pixels giving a resolving power of ∼47,000. For faint objects and depending on the spectral region, one or more fibres can be devoted to recording the sky contribution. In addition, for the 580 nm setup only, a separate calibration fibre is available to acquire simultaneous ThAr calibration spectra. This allows very accurate radial velocity determinations. In this configuration, 7 fibres remain available for targets on sky.

The upgrade of the MIT CCD in the UVES red arm in July 2009 has provided a marked increase in sensitivity in the 860-nm setting and decrease in fringing (see Sect. 1.1).

6.3.2 Observational Requirements

The operation of FLAMES requires the observer to have his/her own list of target coordinates, with a relative astrometric accuracy better than 0.″3, when preparing Phase 2. **Bad astrometry results in large losses at the fibre entrance and therefore in much poorer performance.** The minimum object separation is 11″. The Fibre Positioner is able to place the fibres with an accuracy better than 0.″1. During Phase 2 it is necessary to run dedicated software (FPOSS) that assigns the fibres to the selected objects. Considerations regarding the relevant astrometric effects induced by the atmosphere can be found in the FLAMES Users' Manual.

For more detailed information on instrument setups and performance estimates the user is referred to **the FLAMES web page**.

6.3.3 Calibration

All required standard FLAMES calibrations are acquired by the Observatory staff during daytime. No night-time calibrations are foreseen except for screen flatfields (so-called attached flatfields) if additional flatfielding accuracy is required. For ARGUS mode, screen flatfields are taken for Service Mode programmes in twilight together with a spectrophotometric standard star at no extra cost to the user.

6.4 UVES, Ultraviolet and Visual Échelle Spectrograph

UVES is the high resolution optical spectrograph of the VLT and is located at the Nasmyth B focus of UT2. UVES is a cross-dispersed échelle spectrograph designed to operate with high efficiency from the atmospheric cut-off at 300 nm to the long wavelength limit of the CCD detectors (1100 nm). To this purpose, the light beam from the telescope is split in two arms (UV to Blue and Visual to Red) within the instrument. The two arms can be operated separately or in parallel via a dichroic beam splitter. With two dichroic observations, the complete wavelength range (300–1100 nm) can be covered. The resolving power is ∼40,000 when a 1″ slit is used. The maximum (two-pixel) resolution is 80,000 or 110,000 in the Blue- and the Red Arm, while using a 0.4″ and 0.3″ slit respectively. Three image slicers are also available to obtain high resolving power without excessive slit losses. The instrument is built for maximum mechanical stability and therefore allows accurate calibration of the wavelength scale.

The UVES instrument modes offered in Period 86 are listed in Table 6. This table is intended as a quick guide only; for detailed information, proposers should refer to the UVES Users' Manual and Exposure Time Calculator (ETC) available through **the UVES web page**.

Table 6 indicates, for a given mode, the accessible wavelength range, the maximum resolving power that can be obtained, the approximate wavelength range covered in one exposure, and an estimate of the limiting magnitude. **Please note that for each instrument mode standard settings have been defined; in Service Mode, only UVES standard settings are allowed**. Visitor Mode observers are encouraged to use the specially defined UVES standard settings.

The magnitude limits listed in Table 6 are estimated on the basis of the following conditions: continuum source, 0.7″ seeing, 1″ slit, no binning, 3-hour integration, S/N of 10 (per resolution element) at the peak of the central order, no moon. They are indicative of the limiting performance of the instrument only as they depend on the wavelength. UVES proposers should use the ETC for their S/N estimates.

Whether or not an image slicer should be used depends on the trade-off between slit losses due to seeing and the reduced transmission (reduction between 20 and 40%) when using an image slicer. The peculiar spectral formats and the reduced sample of the sky spectrum with the image slicer also have to be taken into account.

Eight interference filters are offered with the UVES RED arm in Visitor Mode. The purpose of these filters is to isolate certain échelle orders to allow the use of the maximum slit length of 30″. The central wavelengths of the filters are chosen to permit observations of the most important emission lines in extended objects. The filters and their central wavelengths are: Hα (656.6 nm),

Table 6: UVES Period 86 instrument modes

Instrument mode	Accessible λ range (nm)	Maximum resolution[1] ($\lambda/\triangle\lambda$)	Covered λ range (nm)	Magnitude limits
Blue arm	300–500	∼80,000	80	17–18
Red arm	420–1100	∼110,000	200–400	18–19
Dichroic#1	300–400 500–1100	∼80,000 ∼110,000	80 200	17–18 18–19
Dichroic#2	300–500 600–1100	∼80,000 ∼110,000	80 400	17–18 18–19
I_2 cell	500–600	∼110,000	200	17

[1] With a 0.4″ (blue) and 0.3″ (red) slit.

Hβ (486.1 nm), OIII (500.7 nm), OIII (436.3 nm), NII (575.5 nm), OI (630.0 nm), SII (672.4 nm), and HeII (468.6 nm). The peak transmissions of the filters range from 70 to 90%.

Finally, in July 2009 the MIT CCD was replaced by an improved version that offers less fringing and higher throughput redwards of ∼800-nm. See the **UVES news page** for details.

6.5 XSHOOTER: multi band, medium resolution échelle spectrograph

XSHOOTER, the first VLT-2nd generation instrument, is the UV-Visual-NIR medium resolution spectrograph mounted at the UT2 Cassegrain focus. Three arms, each with optimized optics, dispersive elements and detectors, allow high efficiency observation simultaneously in the wavelength range 300-2480 nm. The instrument operations started in October 2009 (P84).

Each arm is an independent cross-dispersed échelle spectrograph complete with its own shutter and/or slit mask. The incoming light is split into the three different spectrographs/arms through 2 dichroics that have cut-off wavelengths at 5595Å (for the separation of UVB-VIS light) and 10240Å (for the separation of the VIS-NIR light). Three piezo-controlled mirrors, located in front of each arm, guarantee that the optical path is maintained aligned against instrument flexure and corrected for differential atmospheric refraction between the telescope guiding wavelength and each arm central wavelength. Two pairs of ADC prisms in the optical path of the UVB and VIS arms compensate for the atmospheric dispersion at different airmasses.

Two instrument modes are offered: (short) slit spectroscopy (SLT) with a selection of different slit widths for each arm and a fixed length of 11 arcsec, and IFU spectroscopy, which allows observing a field of 1.8×4 arcsec^2 reformatted to a 0.6×12 arcsec long-slit. The spectral format is fixed. The orders in each detector are highly curved and the sky/arc lines within each order are highly tilted.

DITs of 1800 s in the NIR arm are no longer offered as they lead to remnants.

Refer to the **the XSHOOTER pages**, User Manual and **XSHOOTER SM rules** for any update and news.

6.6 ISAAC, Infrared Spectrometer And Array Camera

ISAAC is an infrared (1–5 μm) imager and spectrograph mounted at the Nasmyth A focus of UT3. It has two independent arms, one equipped with a 1024×1024 Hawaii array and the other with a 1024×1024 InSb Aladdin array. The Hawaii arm is used at short wavelengths (1 – 2.5 μm). The Aladdin arm is udsed predominantly at long wavelengths (3–5 μm) but is also available for short wavelength imaging with broad band filters. Below we summarise in two tables the operational modes and the performance of ISAAC. These tables are only intended to be quick reference guides. Proposers should refer to the detailed information available via **the ISAAC web pages**.

Important note: Due to the planned installation of SPHERE, scientists interested in submitting Large Programme proposals for ISAAC should carefully plan their time request, because ESO cannot guarantee ISAAC observations beyond the end of P86 (March 2011).

During Period 86 we will continue to offer all ISAAC instrument modes already offered in Period 85 (*i.e.*, short-wavelength imaging, spectroscopy and polarimetry, and LW imaging and spectroscopy) in both Visitor Mode and Service Mode (Sections. 12.1) and 12.2).

Since Period 80 we have offered two new imaging modes with the Aladdin detector: Burst mode and FastJitter mode. They are offered in both Visitor Mode and Service Mode. However, please note that for lunar occultation observations only disappearances can be supported in Service Mode; appearances must be in Visitor Mode. The Burst and the FastJitter modes are intended for fast relative photometry (of the order of a few milliseconds) with the hardware windowed Aladdin array. Technical details, restrictions and overheads of the new modes are available at **the ISAAC web page**.

Table 7: ISAAC Period 86 offered imaging modes

Instrument Mode	Scale ($''$/pixel)	FOV (arcsec^2)	Magnitude limits
SW Imaging[1]	0.148	152×152	J=24,H=23,Ks=22
SW Polarimetry	0.148	$3 \times 20 \times 150$[2]	J=23,H=22,Ks=21
LW Imaging	0.071	73×73	L≈16, M_NB≈13
LW Imaging 3.21, 3.28 μm	0.148	152×152	L≈16
LW FastPhot (JHK)	0.148	4.7×4.7 to 152×152	–

[1] For both the Hawaii and Aladdin arrays

[2] In polarimetry the FOV consists of three non-overlapping strips each of $20'' \times 150''$

The magnitude limits (c.f. Table 7) are the J (1.25 μm), H (1.65 μm), Ks (2.2 μm), and L (3.8 μm) background-limited magnitudes for a flat spectrum point source that would result in a S/N of 5 in one hour of integration under typical background conditions and a seeing FWHM of $0''.65$.

In addition to the standard J, H, Ks, and L broadband filters, ISAAC is equipped with a wide selection of narrow-band (typically $\Delta\lambda/\lambda \approx 0.015$) filters. It is not possible to observe using ISAAC with user-supplied filters.

The magnitude limits given in Table 8 are the short wavelength (SW) and long wavelength (LW) magnitudes of a flat spectrum point source that would result in a S/N of 5 per resolution element in the continuum in one hour of integration under typical background conditions, a seeing FWHM of $0''.65$, and using a $1''.0$ slit. Limits on IR spectroscopic capabilities vary strongly with wavelength due to the absorption/emission spectrum of the atmosphere; the range of values given in Table 8 reflects this variation.

6.7 VIMOS, VIsible Multi-Object Spectrograph

VIMOS will be refurbished during Period 85. Details on the scope of the upgrade project, expected performance, validity of pre-imaging observations, and availability of the instrument are given in the News section of the VIMOS web pages.

Table 8: ISAAC Period 86 offered spectroscopic modes

Instrument Mode	$\lambda/\Delta\lambda$	Scale ($''$/pixel)	Mag–limit Range
SW LRes Spectroscopy	≈ 500	0.147	18–20.5
SW MRes Spectroscopy	≈ 3000	0.147	17.5–19.5
LW LRes Spectroscopy	≈ 500	0.147	11–14
LW MRes Spectroscopy	≈ 2000	0.147	10–13

Table 9: VIMOS Period 86 offered settings and modes

Mode	Scale	FOV	Wavelength range (nm) [1]	$\lambda/\Delta\lambda$ [2]	Dispersion Å /pix	Spectral multiplex[3]
IMG *UBVRIz*	0.205″/pix	$4 \times 7' \times 8'$	–	–		–
MOS LR Blue	0.205″/pix	$4 \times 7' \times 8'$	370–670	180	5.3	4
MOS LR Red	0.205″/pix	$4 \times 7' \times 8'$	550–950	210	7.3	4
MOS MR	0.205″/pix	$4 \times 7' \times 8'$	480–1000	580	2.5	1
MOS HR Blue	0.205″/pix	$4 \times 7' \times 8'$	415–620	2050	0.5	1
MOS HR Orange	0.205″/pix	$4 \times 7' \times 8'$	520–760	2150	0.6	1
MOS HR Red	0.205″/pix	$4 \times 7' \times 8'$	630–870	2500	0.6	1
IFU LR Blue	0.67″/fibre	$54'' \times 54''$	390–670	220	5.3	4
IFU LR Red	0.67″/fibre	$54'' \times 54''$	580–915	260	7.3	4
IFU MR	0.67″/fibre	$27'' \times 27''$	490–1015	720	2.5	1
IFU HR Blue	0.67″/fibre	$27'' \times 27''$	415–620	2550	0.5	1
IFU HR Orange	0.67″/fibre	$27'' \times 27''$	525–740	2650	0.6	1
IFU HR Red	0.67″/fibre	$27'' \times 27''$	640–860	3100	0.6	1
IFU LR Blue	0.33″/fibre	$27'' \times 27''$	390–670	220	5.3	4
IFU LR Red	0.33″/fibre	$27'' \times 27''$	580–915	260	7.3	4
IFU MR	0.33″/fibre	$13'' \times 13''$	490–1015	720	2.5	1
IFU HR Blue	0.33″/fibre	$13'' \times 13''$	415–620	2550	0.5	1
IFU HR Orange	0.33″/fibre	$13'' \times 13''$	525–740	2650	0.6	1
IFU HR Red	0.33″/fibre	$13'' \times 13''$	640–860	3100	0.6	1

[1] In MOS mode, with the LR and MR settings, the actual spectral range depends also on the order separation filter used; with the HR settings, the actual spectral coverage depends also on the position of the slit in the field of view.

[2] This is the resolution given by a slit with width 1″ in MOS mode, and by 1 fibre in IFU mode.

[3] This is the number of slitlets that can be accommodated along the dispersion direction.

VIMOS is a multi-mode, wide-field optical instrument attached at the Nasmyth B focus of Melipal (UT3). VIMOS allows imaging (IMG) and multi-object spectroscopy (MOS) at low- ($R \sim 200$) to medium-resolution ($R \sim 2500$) over a field of view (FOV) composed of four quadrants, each $7' \times 8'$, separated by $2'$ gaps. MOS masks, which are prepared with the Mask Manufacturing Unit (MMU) on Paranal, allow considerable freedom in the positioning, shape, and orientation of the slits. The maximum number of slits that can be typically accommodated in the VIMOS FOV is up to 750 at low resolution, and up to 150 at higher resolution. The actual number of slits will depend on the multiplex used, target density and their distribution in the field of view.

VIMOS is also equipped with an integral field unit (IFU) with 6400 microlenses coupled to fibres, with a choice of two spatial samplings (magnifications): 0.67″ per fibre or 0.33″ per fibre. With the lower spectral resolution settings, the FOV of the IFU is $54'' \times 54''$ (using the 0.67″ magnification), or $27'' \times 27''$ (using the 0.33″ magnification). A quarter of these fields are covered at intermediate to higher spectral resolutions.

The VIMOS instrument works in the wavelength range 360–1000 nm. VIMOS modes (IMG, MOS, and IFU) are summarised in Table 9. Users should refer to the detailed information available on **the VIMOS web page** to assess the feasibility of their programme with VIMOS.

All instrument modes and settings are offered both in Visitor Mode (Sect. 12.1) and Service Mode (Sect. 12.2), except for pre-imaging runs, which are carried out in Service Mode only.

Table 10: VIMOS IMG limiting magnitudes

Magnitude limit (S/N=5)					
U=25.9	B=27.2	V=26.8	R=26.4	I=25.5	z=24.6

The magnitude limits in Table 10 correspond to a one-hour integration with dark sky, clear con-

ditions, a seeing of 0.8″ and an airmass of 1.2, for a point source of zero colour (A0V star) giving S/N∼5. The magnitude limits in **MOS mode** are ∼ 23.8 for the lower resolution settings and ∼ 22.2 for the higher resolution settings (S/N is computed per pixel integrated along the slit direction; it refers to central wavelength and corresponds to a 1.0″ slit); in **IFU mode**, ∼ 23.3 for the lower resolution settings and ∼ 20.8–21.5 for the higher resolution settings (depending also on the spatial magnification). These values should only be used as a *rough guide*. Users should refer to the Exposure Time Calculator, available at (**http://www.eso.org/observing/etc**), to test the feasibility of their programme and to estimate the corresponding execution time. Performances in the I and z bands are expected to improve significantly following the June-July 2010 upgrade. The observing overheads are given in Table 19 and more details are given in the VIMOS web pages.

Note: For MOS runs ESO will consider OBs as successfully executed when at least 3 of the 4 quadrants are operational and work within specifications.

Below we summarise some important requirements for OB preparation that must be taken into account during Phase 1.

6.7.1 VIMOS Observation Requirements: IMG

Offsets > 30″ during OB execution often cause the loss of the guide star, resulting in large operational overheads. For this reason, offsets > 30″ are not allowed with VIMOS. If an offset pattern with a greater amplitude is needed, users should use separate OBs at each offset position. Please make sure you take into account the increased overhead time due to this feature when estimating the total time needed for VIMOS imaging runs.

In IMG mode, filter exchanges are allowed within an OB. Overheads for filter exchanges should be taken into account using the estimate given in Table 19.

6.7.2 VIMOS observation requirements: MOS and pre-imaging

MOS observations are performed with machine-cut masks that have to be prepared well in advance. ESO provides a software package (**vmmps**) for slit definition and positioning for Phase 2 preparation (equivalent to FIMS for the FORS instruments). The user can define rectangular slits of width wider than 0.6″ and length up to 30″. Inclined slits can be defined.

The change of CCDs, scheduled to happen during P85 (June-July 2010), will invalidate all pre-imaging data taken before August 1, 2010.

Pre-imaging is mandatory for subsequent spectroscopic (MOS) follow-ups, even when targets come from a pre-defined catalogue, and must be carried out with the *R* filter. Pre-imaging is done in Service Mode (this also applies for MOS Visitor runs); **separate runs must be requested for pre-imaging in the Phase 1 proposal** and associated overheads have to be taken into account by the users. Pre-imaging runs are carried out typically two months in advance of the spectroscopic follow-up. Masks need to be prepared as soon as possible after the pre-imaging has been completed and submitted according to Phase 2 procedures.

The observations taken as part of a pure imaging run (without the pre-imaging flag set) cannot be used for the subsequent mask preparation due to the lack of the controlled mask-to-ccd transformation keywords in the headers. Therefore, even in the case when imaging data have been obtained with VIMOS, the short pre-imaging run is mandatory.

VIMOS is not equipped with an Atmospheric Dispersion Corrector. In order to minimise slit losses, MOS observations and their pre-imaging are taken at a pre-defined position angle on sky, with slits oriented N-S, and the target within 2 h of the meridian. Special requirements for different field orientations should be clearly stated in the proposals.

In MOS mode, instrumental flexures will introduce wavelength offsets if calibration data are taken at a very different rotator angle to the science exposure. In order to minimise these effects *attached night-time arcs are mandatory for the blue settings and strongly recommended for the red settings.* The corresponding overheads need to be taken into account at Phase 1 and can be estimated using Table 19.

In MOS mode only one filter+grism combination per OB is permitted (the only filter exchange allowed is the one between acquisition and science template). Users who want to observe the same targets with different filter+grism combinations are requested to submit separate OBs for different filter+grism combinations and to consider the respective overheads.

6.7.3 MOS Observations in Visitor Mode

Due to the rule that MOS observations should be carried out within 2 h of the meridian, in Visitor Mode it is desirable that the targets are uniformly distributed in RA for the night(s) of the observations. If this is not the case, users should apply for Service Mode observations. For operational reasons a maximum number of **7** visitor masks (per quadrant) will be made available in the instrument each night. If a visitor is granted half nights, the above number is reduced to **3** masks (per quadrant).

Normally, users should submit OBs for mask preparation well before their observing run, so that masks can be manufactured before they arrive. Visitor Mode (VM) observers who wish to use VIMOS in MOS mode are required to submit part of their OBs at least 3 weeks before the first night of the VM run. Exceptionally, limited additional support is guaranteed for mask preparation on the mountain, up to 3 sets of masks per night, to be prepared at least 48 h in advance.

6.7.4 VIMOS Observation Requirements in IFU Mode

In IFU mode instrumental flexures will introduce flatfield residuals and wavelength calibration offsets if the calibration data and the science data are taken at very different rotator angles. In order to minimise these effects *attached night-time arcs and screen flats are mandatory in IFU mode for all settings*. The corresponding overheads need to be taken into account at Phase 1 and can be estimated using Table 19.

In IFU mode, only one filter+grism combination per OB is permitted. Users who want to observe the same targets with different filter+grism combinations are requested to submit separate OBs for different filter+grism combinations and to consider the respective overheads.

6.8 VISIR, VLT Imager and Spectrometer for mid Infra Red

VISIR is the mid-infrared imager and spectrometer at the Cassegraing focus of UT3. It works in the wavelength ranges $8 - 13\,\mu$m and $17 - 24\,\mu$m and has been offered to the community since Period 75.

6.8.1 Imaging Modes offered in Period 86

In Period 86 the **imager** with a 256×256 detector array is offered with image scales of $0\farcs075$/pixel (SF) and $0\farcs127$/pixel (IF). The filters available are: PAH1, ArIII, SIV_1, SIV, SIV_2, PAH2, SiC, PAH2_2, NeII_1, NeII, NeII_2, Q1, Q2, Q3, B8.7, B9.7, B10.7, B11.7, B12.4, J7.9, J8.9, J9.8 and J12.2.
The sensitivities, with only few exceptions, range between about 4 and 20 mJy $10\sigma/1$ h in the N band and between about 50 and 150 mJy $10\sigma/1$ h in the Q band, depending on the selected filter and image scale.
The **Burst** read out mode is offered in **Visitor mode only** for the imager. It allows one to save every single DIT of the observation providing a time resolution of few tens milliseconds, depending on the instrument setup.
Please refer to **the VISIR Web pages** for further details.

6.8.2 Spectroscopy Modes offered in Period 86

The **spectrometer** is offered for N and Q band spectroscopy in the following modes:

- Low resolution (LR) mode with a resolution of $R \approx 350$ in four settings that cover the full N band. Sensitivities are about 50 mJy $10\sigma/1$ h.
- Medium Resolution (MR) mode with a resolution of up to $R \approx 3600$ in the N band for the wavelength ranges of $7.4 - 9.4\,\mu$m and $10.2 - 13.0\,\mu$m, and with a resolution of $R \approx 1800$ in the Q band for the wavelength ranges of $17.1 - 19.0\,\mu$m and $19.9 - 20.3\,\mu$m. Sensitivities are between about 200 and 2000 mJy $10\sigma/1$ h, depending on the spectral range.
- High resolution (HR) mode with a resolution of $R \approx 15000 - 30000$ at wavelengths near the [H2 S4], [NeII], [H2 S1] lines in longslit mode, and a wider range of wavelengths including the [H2 S3], [H2 S2], [ARIII], [SIV], [CoII], [ClIV], [NeII], [CoIII], [CoI], [PIII], [FeII], [NiII], [SIII], [NaIV], HD(0,0) R(9),R(10) lines in cross-dispersed mode. Sensitivities are between about 2 000 and 10 000 mJy $10\sigma/1$ h, depending on the spectral range and mode.

The VISIR spectrometer observing modes have the following restrictions:

- Acquisition is possible with the spectro-imager only for targets brighter than 200 mJy using the N_SW or N_LW filters, and for targets brighter than 50 mJy using the [NeII] filter. Fainter targets can be acquired with restrictions on allowed airmass and slitwidth using the imager with sensitivities as given in the web page.
- Absorption line spectroscopy is untested and flatfielding problems may be anticipated.

The slits cover a range of $0\farcs4 - 1\farcs0$ in width and the image scale of the 256×256 detector array is $0\farcs127$/pixel. Please refer to **the VISIR Web pages** for further details. Note that sensitivity limits in the MIR vary strongly with wavelength due to the atmosphere.

6.8.3 Calibrations

In imaging, one photometric standard star observation will be provided per science target with no cost for the user. In low-resolution spectroscopy, the Observatory will provide spectrophotometric observations of a telluric standard star. Such a calibration measurement will be performed at least once per night, per instrument configuration. The Observatory does **not** provide standard star calibrations for VISIR medium- and high-resolution spectroscopy. If MR, HR or any additional standard star observations are required, the user has to supply his/her own calibration OBs using the corresponding calibration templates. The observing time needed to execute this calibration is charged to the programme.

6.8.4 Exposure Time Calculator

The users are requested to use the ETC (**http://www.eso.org/observing/etc**) in order to test the feasibility of their programme and estimate the corresponding execution time. The corresponding observing overheads are given in Table 19. For more details please consult the VISIR User Manual available at
http://www.eso.org/instruments/visir/doc/.

6.9 HAWK-I, High Acuity Wide-field K-band Imager

HAWK-I is a near-infrared (0.85–2.5 μm) wide-field imager installed at the Nasmyth A focus of UT4.

The instrument is cryogenic (120 K, detectors at 80 K) and has a fully reflective design. The light passes four mirrors and two filter wheels before hitting a mosaic of four Hawaii 2RG 2048×2048 pixels detectors. The final f-ratio is f/4.36 ($1''$ on the sky corresponds to 169 μm on the detector).

As of Period 83, proposers can use the Rapid Response Mode (RRM) to trigger HAWK-I observations. For details on RRM policies, please see Sect. 11.4.1.

On-line information on HAWK-I can be found in the **instrument web pages**.

6.9.1 Filters and field of view

HAWK-I is offered with 10 observing filters placed in two filter wheels: Y, J, H, Ks (with transmission curves identical to the **VIRCAM** filters), as well as 6 narrow-band filters (Brγ, CH4, H2 and three cosmological filters at 1.061, 1.187, and 2.090 μm).

The field of view of HAWK-I on the sky is $7.5' \times 7.5'$, covered by the mosaic of the four Hawaii-2RG chips. The four detectors are separated by a cross-shaped gap of $\sim 15''$. The pixel scale is $0.1064''$/pix with negligible distortions ($< 0.3\%$) across the field of view. The image quality is seeing limited down to at least $0.4''$ seeing (*i.e.*, $0.3''$ measured in K).

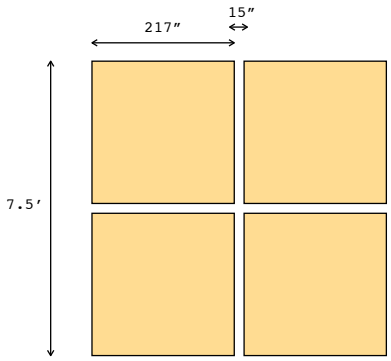

Figure 6: HAWK-I field of view sketch

6.9.2 Brightness limiting magnitude and persistence

The HAWK-I detectors show a persistence effect if the observed sources are heavily saturated, which affects subsequent observations of faint sources. In general, observations of fields containing objects brighter than Ks=8.1 mag, H=9.1 mag or J=8.8 mag should be carried out in Visitor Mode.

6.9.3 Limiting magnitudes

Typical limiting magnitudes of HAWK-I (S/N of 5 on a point source, 3600 s integration on source) under average conditions ($0.8''$ seeing, 1.2 airmass) are given in Table 11.

Table 11: HAWK-I limiting magnitude examples

Filter	Limiting mag [Vega]	Limiting mag [AB]
J	23.9	24.8
H	22.5	23.9
Ks	22.3	24.2

The read-out noise is around 5 e^-, while the dark current of the instrument is around 2 e^-/pix/s.

The **exposure time calculator** should be used for detailed exposure time calculations, in particular for narrow-band filters,

A new *Fast Photometry* mode has been implemented and is offered starting from P86. Please refer to the user manual for information.

6.10 NACO (NAOS+CONICA)

NACO provides adaptive optics-assisted imaging, polarimetry, spectroscopy, and coronagraphy in the 1–5 μm range and is installed at the Nasmyth B focus of UT4.

Important note: Due to the planned installation of MUSE, scientists interested in submitting Large Programme proposals for NACO should carefully plan their time request, because ESO cannot guarantee NACO observations beyond the end of P87 (September 2011).

6.10.1 Adaptive optics correction with Natural and Laser Guide Stars

NAOS, the adaptive optics front end, has been designed to work with Natural Guide Stars (NGS) and *moderately* extended objects. It is equipped with one infrared and one visual wavefront sensor. For a point-like reference source with a visual brightness of V=12, NAOS can provide Strehl ratios as high as 50% (on axis) in the K band in optimal weather conditions. A more realistic value is 40% in good conditions. It can provide partial correction for targets as faint as V=17. Users should use **the preparation software** and **the NACO ETC** for the preparation of their proposals.

Since Period 85, NAOS can also be used with the LGS (LGS mode, see Section 4.2.3 for additional details). Two modes are possible:

- with a tip-tilt star (TTS), of V magnitude in the range 12–18 and with a maximum angular separation of 60″ from the science target. However, the performance of the adaptive optics correction decreases with increasing angular separation from the science targets. Finally, the choice of the TTS imposes some constraints on the field orientation. The name of the TTS must be specified in the target list of the Phase 1 proposal using the ESOFORM proposal template;
- without a tip-tilt star, also called *seeing enhancer mode*. The name of the TTS must be left blank in the target list of the Phase 1 proposal.

It is compulsory to provide the magnitude of the star and the bandpass in which the magnitude is given for both NGS and LGS with TTS. Observations in LGS mode require either clear (CLR) or photometric (PHO) conditions: the transparency constraint must be set accordingly in the proposal.

In addition, LGS without TTS (seeing enhancer mode) must require seeing conditions better than 0.8″. Separate runs should be specified in the proposal form for observations using a NGS, on the one hand, and for LGS observations, on the other hand.

The LGS mode of NACO is offered in Service and Visitor Mode.

6.10.2 Observing modes

CONICA is the imager and spectrograph which is fed by NAOS. CONICA offers a large range of modes, filters, grisms and masks. Only the main characteristics of each mode are described here. Details can be found in **the NACO Users' Manual**.

For low Strehl ratios (a few percent or less), users should carefully weight the advantages of using NACO over other IR instruments such as HAWK-I and ISAAC, which generally have larger fields of view, lower backgrounds and higher throughputs.

A summary of the offered modes is given in Table 12.

Visitor mode must be requested for programmes requiring:

- Lyot coronagraphy, SDI+4 and 4QPM coronography, as flexures inside NACO require the observer to monitor constantly the centering of the star in the coronagraphic spot;
- SAM;
- special calibrations, i.e., calibrations not defined in the NACO Calibration Plan (see Sec. 6.10.6).

SM proposals require a detailed justification for the need for SM and will be considered on a case-by-case basis as part of the technical feasibility evaluation of the Observatory. See Sect. 6.10.6 for details.

The following modes are decommissioned:

- prism and slitless spectroscopy;

Table 12: NaCo modes in Period 86

Imaging	SM and VM	All filters
Imaging + cube	SM and VM	Limited setups
Open loop Imaging + cube	SM and VM	Limited setups
SDI+	SM and VM	Replaces SDI
Lyot Coronagraphy	VM	C_0.7, C_1.4 (all cam), C_0.7_sep_10 (not S13 camera)
4QPM Coronagraphy	VM	Optimized for H and K,
SDI+4	VM	
APP	SM and VM	Simple Imaging, NB and IB_4.05 only
SAM	VM	Includes pupil tracking and cube mode
SAM+Pol	VM	SAM with Woll_00
Polarimetry	SM and VM	Woll_00, retarder plate only
Grism Spectroscopy	SM and VM	all modes except pupil tracking
LGS	SM and VM	See section 4.2.3
LGS/SE	SM and VM	See section 4.2.3
Pupil Tracking	SM and VM	Simple Imaging only (APP included).
Pupil Tracking	VM	All SAM and coronagraphic modes except APP.

- wire-grid polarimetry; instead, users can opt for the Wollaston_00 in combination with the retarder plate;
- Fabry-Perot Imaging; instead, observations with SINFONI should be considered.

6.10.3 Imaging, Polarimetric and Coronagraphic Modes

Imaging, polarimetry and coronagraphy can be done with a variety of filters, pixel scales and fields of view (Table 13).

Table 13: NACO pixel scales and fields of view

Wavelength range	Scale (mas/pix)[1]	FOV (arcsec)
SW filters[2]	54.3	56×56
SW filters	27.0	28×28
SW filters	13.3	14×14
NB_4.07,NB_3.74	54.7	56×56
NB_4.07,NB_3.74, L′	27.1	28×28

[1] For reference: the diffraction limited FWHM of a point source imaged with an 8m telescope are J(32 mas), H(42 mas), Ks(56 mas), L′(98 mas), and M′(123 mas).

[2] Short Wavelength (SW) filters refer to filters with wavelengths shorter than 2.5 μm.

Polarimetry observations are carried-out using the retarder plate and the Wollaston_00. J-band polarimetry observations are not possible because of the location of the J filter in the same wheel as the Wollaston.

Coronagraphy can be done with occulting masks of 0.7″ and 1.4″ in diameter, as well as with a semi-transparent mask of 0.7″ diameter, with a transmission of 0.4% (0.3%) for H-band (Ks-band). Since Period 80, the two new "four quadrant phase" (4QPM) masks are offered in Visitor Mode. One mask is optimised to work at K band (4QPM_K) and offers a 13″ × 13″ FOV, while the other one (4QPM_H) is optimised for H band observation and has an 8″ × 8″ FOV. Accurate centering is critical for the performance of the 4QPM and it is the main reason why these modes are offered only in VM. Recent investigation has also found out that flexures affect the centering of the Lyot masks, by up to 1.5 pixels; for this reason, Lyot coronagraphy has been moved to VM as well.

The approximate limiting magnitudes for imaging are listed in Table 14. These limits depend on many factors such as the readout mode, the NAOS dichroic, etc. Users should use

the preparation software and **the ETC** for detailed calculations.

Table 14: NACO magnitude limits with the NAOS visual dichroic

Band	J	H	Ks	L′
FWHM [mas]	32	42	56	98
Sky Background [mag]	16.0	14.0	13.0[1]	3.0
Limiting Magnitude[2]	24.05	24.05	23.35	18.55

[1] With the NAOS N90C10 dichroic, the background for Ks is 11.0 mag per square arc second.
[2] 5 sigma in 1 hour using a V=11.5 mag reference 10″ away from the source with a visible seeing of 0.8″. Please note that these limits are valid for point sources and have been computed over apertures with a radius of 1.25 times the values listed in the first row. For NB filters, subtract 2 to 3 magnitudes; for spectroscopy, subtract 4 to 5 magnitudes.

For L′-band imaging without chopping, observations are done only with the AutoJitter template to ensure proper sky subtraction.

6.10.4 Simultaneous Differential Imager (SDI+)

This is a high contrast imaging mode using the simultaneous differential imager (SDI+), which has been offered since Period 81. Contrasts of 30,000 can be obtained at 0.″5 in 40 min at S/N of 6 between a bright (H< 7 mag) primary star and a methane rich ($T_{\rm eff}$ < 1000 K) companion. The pixel scale of this mode is 17.25 mas/pixel and the FOV is ≈ 8″×8″. SDI+ replaces the old SDI, which is not offered anymore. The performance of SDI+ is equivalent to that of SDI, but the mode offers a larger square FOV of 8″ x 8″, with the same pixel scale. For more information, consult the NACO web pages.

6.10.5 Spectroscopic Modes

Grism spectroscopy can be carried out using two slit widths (86 mas and 172 mas). The slits are 40″ long (restricted to 28″ for the S/L27 cameras).

Prism and slitless spectroscopy are decommissioned.

6.10.6 NACO Calibration plan and special calibrations

The NACO **calibration plan** does not support all combinations of detector readout mode and instrument setup. Observations requiring special calibrations must be carried out in VM. In exceptional cases, SM observations that require special calibrations will only be considered if the following information is provided in the proposal form:

- A comprehensive justification of the need for SM observations as opposed to VM (Box 8D of the proposal form)
- A detailed description of the calibration strategy and needs in Box 9.
- Specification of the need of special calibrations in Section 14, by uncommenting the provided lines.

Users are encouraged to send requests and questions to **usd-help@eso.org**.

Night time calibrations is charged to the allocated observing time.

6.11 SINFONI, Spectrograph for INtegral Field Observations in the Near-Infrared

SINFONI is a near-infrared (1–2.5 μm) integral field spectrograph fed by an adaptive optics (AO) module. It is currently installed at the Cassegrain focus of UT4.

The spectrograph operates with 4 gratings (J, H, K, H+K) with spectral resolutions of 2000, 3000 and 4000, corresponding to the J, H and K gratings respectively, and R$\sim$1500 with the H+K grating. Each wavelength band fits fully onto the Hawaii 2RG (2k×2k) detector. The SINFONI field of view on the sky is sliced into 32 slices. The pre-slit optics allows one to choose the width of the slices. The choices are 250 mas, 100 mas and 25 mas, leading to fields-of-view of $8''\times8''$, $3''\times3''$, and $0.8''\times0.8''$, respectively. Each one of the 32 slitlets is imaged onto 64 pixels of the detector. Thus, one obtains $32 \times 64 = 2048$ spectra of the imaged region of the sky.

The adaptive optics module of SINFONI can be used with natural guide stars (NGS), the laser guide star (LGS), or without guide stars (the noAO mode), in which case the AO module just acts as relay optics and the spatial resolution is dictated by the natural seeing. If more than one of these modes are used in a given programme, they should be requested as part of different runs.

In the NGS mode, the star should be brighter than R $\sim$ 11 mag for peak performance. However, the AO can work (and will provide moderate image quality improvement) with stars as faint as R $\sim$ 17 mag in excellent seeing conditions. Ideally, NGS should be as close as possible to the scientific target (if not the science target itself), and usually closer than $10''$. The NGS can be chosen to be as far as $30''$ away from the science target (or as far as $60''$ but with some constraints on the field orientation), and, depending on atmospheric conditions, the AO system can still provide a mild improvement in the encircled energy. The name of the NGS must be specified in the target list of the Phase 1 proposal using the ESOFORM proposal template.

The LGS mode (see Section 4.2.3 for additional details) can be used with or without a tip-tilt star. In Period 86 the LGS mode of SINFONI is offered in Service and Visitor Mode.

If a tip-tilt star (TTS) is used, it should be in the V magnitude range 12–18 and can be as far away as $60''$ from the science target. However, performance decreases with increasing distance, and there are some constraints on the field orientation. The name of the TTS must be specified in the target list of the Phase 1 proposal using the ESOFORM proposal template.

The LGS mode without a tip-tilt star (the so-called seeing-enhancer mode) has been offered since Period 85. Users requesting this mode must specify CLR or better for the transparency, and a seeing better than $0.8''$ in their Phase 1 application. In the target list of the Phase 1 proposal using the ESOFORM proposal template, please leave the TTS name blank. If the user of the LGS mode without a tip-tilt star requires observation of a PSF calibrator associated with a science target, this PSF calibrator has to be observed via a separate OB (i.e., the template 'SINFONI_ifs_cal_PSF' cannot be used within the science OB itself); for the observation of the PSF calibrator sufficient time must be requested in the proposal.

The `fast_acquisition` template must be used only in case of acquisition of bright targets, which would saturate the detector in closed loop with the large scale. Excellent astrometry is required for this acquisition mode.

As of Period 85, proposers can use the Rapid Response Mode (RRM) to trigger SINFONI observations. This mode is offered with the NGS and noAO modes of SINFONI. For details on RRM policies, please see Sect. 11.4.1.

Pre-Imaging runs can also be proposed with SINFONI. Such observations are typically dedicated to test the feasibility of a specific science programme (e.g. faint target, difficult acquisition).

6.11.1 Instrument Performance

Table 15 gives the limiting magnitudes (S/N of 5) for continuum sources integrated over the typical size of the point-spread function in one hour of integration time.

These values were calculated for a visual seeing of $0.8''$ which would provide infrared seeing values

Table 15: SINFONI fields of view and limiting magnitudes

Field of View	Spatial Scale	Mode	Limiting Magnitudes (continuum)
$8''\times 8''$	125×250 mas	noAO	J=20.2, H=19.9, K=17.9, H+K=19.6
$3''\times 3''$	50×100 mas	NGS	J=19.4, H=19.6, K=18.8, H+K=19.8
$0.8''\times 0.8''$	12.5×25 mas	NGS	J=17.8, H=18.7, K=18.3, H+K=19.2

of 0.67″, 0.63″, 0.59″ and 0.61″ at the central wavelength of the J, H, K and H+K gratings, respectively. For the closed loop adaptive optics observations with natural guide stars (NGS) we have assumed a guide star at a distance of 10″ with a photometric brightness of R = 12 and B−R = 1.5 magnitudes. We encourage the use of the exposure time calculator for more detailed estimates (**http://www.eso.org/observing/etc**).

6.11.2 Brightness Limits

To avoid saturation of the detector and detector persistence, which affects subsequent observations of faint sources, no objects with J, H, K magnitudes < 6 mag must be visible in a field of view of 15″ around the AO guide star and/or the science target. However, if `fast_acquisition` is used, the limits are brighter by 1 and 2 magnitudes for 0.″1/pix and 0.″025/pix respectively.

6.11.3 Sky Subtraction

The user should note that sky offset fields are mandatory for observations in the 25 and 100 mas scales. The corresponding overheads have to be taken into account when estimating the required time for an observing run. Typically, 50% (or 33%) of the observing time is spent on sky if $\mathrm{NDIT_{Sky}} = \mathrm{NDIT_{Target}}$ (or $\mathrm{NDIT_{Sky}} = 1/2\ \mathrm{NDIT_{Target}}$).

6.11.4 Calibrations

Observations of telluric standard stars at an airmass within ±0.1 of the science observation will be offered as part of the SINFONI calibration plan for all modes available (*i.e.*, for all combinations of image scales and gratings). Darks, internal flat-fields, and wavelength calibrations are also part of the SINFONI calibration plan and are taken during daytime. Time to obtain special calibrations, such as observations of PSF reference stars, must be requested in the proposal.

6.11.5 Modes that are not offered

Observations with the sky spider and spectral dithering are not offered in Period 86.

6.12 MIDI, MID-infrared Interferometric instrument

MIDI is the VLTI instrument for N-band ($8 - 13\,\mu$m) interferometry. It is a two-beam recombiner giving values of moduli of fringe visibility (samples in the (u,v) plane) depending on the wavelength (spectral resolution: $R = 30$ or $R = 230$). MIDI has been offered in both Service and Visitor Modes since Period 73 and can be used with either the UTs or the ATs. For a list of the offered telescope configurations, please refer to **the VLTI baseline page**.

The main features of MIDI for Period 86 are:

- Interference fringes recorded in “dispersed-Fourier” mode (long slow scan with coherencing at 1-Hz rate).
- Spectrograph optics: either NaCl PRISM mode ($R = 30$), or KRS5 GRISM mode ($R = 230$).

Table 16: MIDI limiting uncorrelated flux (LUF).

Telescopes	Beam combiner	Spectrograph	Limit (N mag)	Limit (Jy@12μm)
UTs	HIGH_SENS	PRISM	4	1
UTs	HIGH_SENS	GRISM	2.8	3
UTs	SCI_PHOT	PRISM	3.2	2
UTs	SCI_PHOT	GRISM	2	6
ATs	HIGH_SENS	PRISM	0.74	20
ATs	HIGH_SENS	GRISM	0.31	30
ATs	SCI_PHOT	PRISM	0.0	40
ATs	SCI_PHOT	GRISM	-0.44	60

- Beam combiner optics: either "HIGH_SENS" (no simultaneous photometric measurement of beams before combination), or "SCI_PHOT" (simultaneous photometric measurement).
- Limiting uncorrelated magnitudes are given in Table 16.
- For MIDI, the correlated flux is defined by the uncorrelated flux (in Jy@12μm) multiplied by the estimated visibility. The MIDI limiting correlated flux (LCF) can be obtained for each mode from the MIDI limiting uncorrelated flux (LUF) of this mode (see Table 16), using the formulae :
  - Without FINITO: LCF= 0.5 $\times$ LUF
  - With FINITO LCF= 0.1 $\times$ LUF
- Various spectral filters for acquisition images.

Details on MIDI and its instrumental modes can be found on the **MIDI web page**.

The raw accuracy of the visibility measurements is typically better than 20%. The highest accuracy for calibrated visibilities can be obtained in SCI_PHOT mode, provided target and calibrator are both brighter than 15Jy for UTs and 200Jy for ATs. The visibility of the Science source is absolutely calibrated by observing a Calibration Source. We offer two calibration modes, either Science-Calibration (SCI-CAL) for normal accuracy requirements, or Calibration-Science-Calibration (CAL-SCI-CAL) for high accuracy requirements.

A proposal can consist of different observations of the same target with different baselines and/or hour angles in which case the observing time to be requested is simply computed as the number of required time-slots multiplied by the duration of one slot as given in Table 19. Time constrained observations (*e.g.* variable objects) can further be requested in the appropriate section of the proposal.

FINITO (the VLTI fringe-tracker) is available with MIDI on the ATs and in Visitor Mode only (since there is no pipeline to process MIDI data by blind coherent integration). It provides co-phasing in the N-band with an accuracy close to 0.12 rad RMS at 10 μm. Users must be aware that the limiting uncorrelated flux of the target for MIDI remains unchanged and, to be observable by FINITO, the target should have:

- Hmag: $-2...5$ (ATs)
- Visibility in H: $> 15\%$ (ATs)

6.13 AMBER, Astronomical Multi-BEam combineR

AMBER is a near-infrared, multi-beam interferometric instrument, combining up to 3 telescopes simultaneously. In Period 86, AMBER can be used with UTs or ATs. For specifications of the UT and AT performances see Sect. 4.2.2 and Sect. 4.2.5. All possible triplets of UTs are available,

and a number of selected AT combinations. For the telescope positions and baseline lengths of the different AT and UT baselines, please refer to **the VLTI baseline page**.

Because of the limited availability of UTs for AMBER, any scientific programme on the UTs should be designed so that scientifically meaningful results can be achieved in a single night.

6.13.1 Spectral Modes and Coverage

The following spectral modes are offered: the Low Resolution H+K bands (LR-HK), Medium Resolution K band (MR-K), High Resolution K band (HR-K) and Medium Resolution H Band (MR-H). For central wavelengths and wavelength coverages for LR-HK, MR-K, MR-H and HR-K see **the AMBER web page.**

Using a short DIT (<180 ms, in medium or high resolution, and <25ms in low resolution), limits the spectral range that can be recorded because the detector has to be windowed to increase readout speed. Users interested in obtaining visibility measurements at several spectral positions inside the range allowed by each configuration can add up to two additional spectral bands.

6.13.2 Integration times, DIT

External fringe tracking with FINITO is available on both the UTs and the ATs. The use of FINITO allows the entire AMBER detector to be read, maximizing simultaneous spectral coverage. It also allows the AMBER DITs to be adjusted to yield sufficient signal-to-noise ratio per frame in the fringes. However, the DIT has to remain small since, even with the help of the fringe tracker, interferometric fringes get significantly blurred after integrations lasting seconds. Note that Medium and High Resolution are only offered with external fringe-tracking as standard setup.

If no fringe tracker is used (*i.e.*, faint and/or extended objects, or airmass too high) the integration times with AMBER will have to be short to minimise the blurring caused by the atmospheric turbulence. In Low Resolution, without external fringe tracking, the maximum authorized DITs are set to 100ms on the ATs and 50ms on the UTs. If *absolute visibility* measurements is the goal, the shortest authorized DITs are recommended (see table 2. in the Template manual); if *closure-phase* and *wavelength differential-mode* are the quantity of interest, the maximum recommended DIT should be used.

Special Modes: Special programs may require a different combination of mode and DIT. This is the case when using MR or HR without external fringe-tracking. A shorter DIT strongly reduces the limiting magnitude. It also reduces the spectral coverage that can be read (see Sect. 6.13.1). Any proposal requiring a non-standard DIT should carefully detail the justification and the technical feasibility. It will be scheduled in Visitor Mode.

In service mode the AMBER DITs ought to be chosen while preparing the Phase II. The AMBER template manual, available on the AMBER documentation page, provides the recommended DITs for all offered configurations.

6.13.3 Limiting magnitudes

AMBER and the VLTI have limitations in magnitude (V-band, H-band and K-band), fringe contrast (H-band and K-band), airmass and seeing. The details of these limitations can be found on **the AMBER web page:**, as well as the most updated values on Visibility accuracy and Closure phase accuracy.

The limiting magnitudes are estimates on the basis of at least 50% of the frames being successfully processed by the AMBER pipeline. If a lower yield rate is accepted, an increase of up to 0.5 in the limiting magnitude can be achieved. In this case, the user should account for additional integration in the same spectral band (see Sect. 6.13.5) to obtain more frames.

The limiting correlated magnitude depends on the AMBER spectral resolution and the FINITO tracking mode (No-Tracking, Group-Tracking or Fringe-Tracking). The main interest of FINITO

Group-Tracking on faint magnitude is to enhance the SNR on the AMBER closure-phase, but reducing the flux in the H-band.

In order to be observable with FINITO, the target should have:

- Hmag: $-2...5$ (ATs) 1...7 (UTs)
- Visibility in H: $> 15\%$ (ATs) $>10\%$ (UTs)

6.13.4 Calibration strategies

AMBER requires frequent calibration on-sky, using calibrator stars. We offer two calibration modes: "CAL-SCI-CAL" and "CAL-SCI". The first one is the standard mode which should be used in most cases, in particular when *absolute calibration* is required for best accuracy. Absolute calibration is required in most program, but for some programs, *wavelength differential quantities* provide the astrophysical information. In that case, "CAL-SCI" (or "SCI-CAL") is sufficient.

The choice of on-sky calibration strategy should be specified in the "calibration request" section of the proposal. **That strategy will be reviewed particularly carefully during the technical feasibility. Proper justification must be provided in case one wants to use "CAL-SCI" instead of the standard "CAL-SCI-CAL".**

6.13.5 Execution times

For each Observing Block (OB), either SCI or CAL:

- Acquisition requires 15min in HR or MR, 10 minutes in LR, including the spectrograph setup and the recording of the calibration fringes (so called P2VM).
- Integration requires 15min. A maximum of 3 integrations is allowed per OB, which could consist in repeating 3 times the same integration or covering 3 different wavelength ranges within the same spectral setup.

Hence a normal "CAL-SCI-CAL" sequence requires 90min in MR or HR, 75min in LR.

When observing targets close to the limiting magnitude in MR or HR, it is recommended to double or triple the integration, and to focus on *wavelength differential quantities*. Hence a "CAL-SCI" sequence with triple integration requires $2x$1h=2h.

Using non-standard DIT (below 200ms in MR and HR, or below 25ms in LR, see Sect. 6.13.2) can strongly reduce the spectral coverage available within one integration. To obtain measurements at different position within the range of the spectrograph setup, the user can use 2 or 3 integrations with different central wavelengths (see Sec. 6.13.1).

6.14 VIRCAM, VISTA InfraRed CAMera

VISTA (see Sec. 4.2.6) is equipped with the near infrared camera VISTA InfraRed CAMera (VIRCAM), which covers a 1.65 degree diameter field of view with a loosely packed detector mosaic totalling $\approx$ 67 million pixels of mean size $0.339''$. The point spread function (PSF) of the telescope+camera system (including pixels) is measured to have a full width at half maximum (FHWM) of $0.51''$. There is no open time available on VIRCAM in P86.

6.14.1 Filters

The only moving part in the camera is the filter wheel. In addition to the sets of filters listed in Table 17, it also includes one available position that can hold a further set of 16 filters (1 per detector). This filter slot is planned to be available for "visitor" filters in the future (cf. below). Due to the complexity of the cryogenic VIRCAM instrument and the VISTA facility possible filter exchange

will be linked to instrument and telescope maintenance intervals. Regular instrument maintenance is expected to be scheduled about every two years.

The list of the currently offered filters is given in Tab. 17. All filters are used in the approved public surveys.

Table 17: VISTA filters

Filter	Wavelength [μm]	FWHM [μm]	Comment
Z	0.88	0.12	required by public surveys
Y	1.02	0.10	required by public surveys
J	1.25	0.18	required by public surveys
H	1.65	0.30	required by public surveys
Ks	2.15	0.30	required by public surveys
NB1.18	1.18	0.01	required by public surveys

6.14.2 Focal plane geometry

The sixteen 2048×2048 pixel IR detectors (Raytheon VIRGO HgCdTe $0.84 - 2.5\mu$m) in the camera are not buttable and are arranged as shown in Fig. 7. The diagram shows the focal plane as it would be seen looking directly down the camera body (down the Z-axis which on the telescope points towards the sky). On the sky (in the default instrument rotator position) +Y corresponds to N, and +X to West.

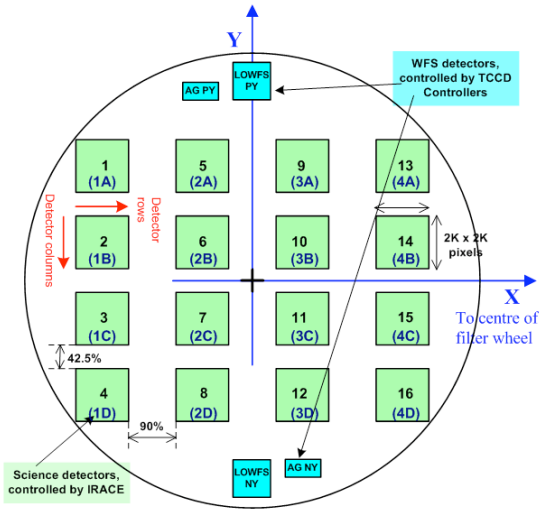

Figure 7: VIRCAM focal plane geometry

A single integration of length DIT secs (or a co-added series of these known as an Exposure) produces a sparsely sampled image of the sky known as a *Pawprint*. The area of sky covered by the pixels of a pawprint is 0.6 deg^2. Full almost uniform sky coverage of a *Tile* of 1.501 deg^{2}can be achieved with six pawprints, offset by $\pm$47.5% in y at two respective x-positions offset by 95% of the detector size. Any sky position of a tile will fall at least on two of these six pawprints.

6.14.3 Instrument performance

Table 18 summarizes the instrument performance as established during commissioning. The instrument performance can be further evaluated from the publicly available Science Verification data sets which are available through **the VISTA Science Verification web page.**

Table 18: VISTA performance

pixel scale	0.34″/pixel
best image quality achieved	0.6″including seeing, optics and sampling
estimated image quality	Paranal seeing convolved with the instrument PSF of 0.51″
image distortion	$< 15\%$ in the corners
photometric calibration	$\pm 2\%$ RMS in respect to 2MASS in J, H, Ks
photometric calibration	$\pm 2\%$ RMS internally
sky concentration/illumination	$< 5\%$ absolute, can be corrected down to $< 2\%$
detector	16 Raytheon VIRGO HgCdTe arrays, sensitive over 0.84 to 2.5μm, high quantum efficiency, large number of hot pixels, some dead areas on detector 1

6.14.4 VISTA Public Surveys and Call for Proposals

VISTA will be dedicated for its first five years of operation primarily to the execution of six public surveys. For details please refer to the **the VISTA Public Survey web page.** Regular public survey operations start as of Period 85.

One year after the start of regular survey operation, science time will be made available to Chilean *Host State Proposals* according to the ESO – Chile host state agreement (cf. Sect. 11.9). At the same time up to 15% of the available observing time will become available to the community through the corresponding ESO Call for Proposal (currently planned for Period 87). The proposals received will be considered in scientific competition with the ongoing public surveys, with any unallocated time returned to the public surveys. All VISTA observations are carried out in Service Mode.

Users who plan to propose their own "visitor" filter set to be used in their science programme have to consider that only one free slot will be available in the VIRCAM filter wheel and that the selected filter will be mounted for a minimum of two years corresponding to the planned maintenance intervals of the instrument. At proposal submission, the proposal PI will have to demonstrate the availability of the visitor filter set, its compatibility with the instrument requirements, and the basic performance of the individual filters.

6.14.5 VIRCAM calibration plan

The VIRCAM calibration plan is currently under review, to include the experience of the Science Verification and Dry Runs. Future applicants should presume that the photometric calibration is based on 2MASS stars in the field of view, with an extinction correction according to Hodgkins et al. 2009 (MNRAS 394, p. 675) in the extrapolated Y and Z bands. Future applicants will have to include the time for additional standards in their proposals.

7 Scientific Instruments: Chajnantor

7.1 SHFI

The APEX Swedish Heterodyne Facility Instrument SHFI contains 4 single pixel receivers:

- APEX-1: a Single Side Band (SSB) SIS receiver covering 211–275 GHz with SSB receiver temperature $T_{\rm rec}$ around 130 K between 210 and 260 GHz and 180 K between 260 and 270 GHz. APEX-1 covers lower frequencies than previously offered at APEX, allowing observations during conditions with PWV>2 mm.
- APEX-2: a Single Side Band receiver covering 275–370 GHz with SSB receiver temperature $T_{\rm rec}$ around 135 K. APEX-2 has replaced the APEX-2A Double Side Band receiver, whose frequency coverage is assured by APEX-2 at similar sensitivity.

- APEX-3: a Double Side Band (DSB) SIS receiver covering 385–500 GHz with DSB $T_{\rm rec}$ around 110 K. As the SSB version of this receiver has not yet been mounted in the cryostat, this receiver is offered conditionally to successful integration and commissioning. Observations in this frequency range require the best quartile of precipitable water vapour conditions (PWV <0.5 mm). Only a limited amount of observing time will be available on APEX-3, so proposals should be self-contained and the requested amount of time should be modest.
- APEX-T2: a Double Side Band (DSB) HEB receiver operating at 1.25-1.39 THz with DSB $T_{\rm rec}$ around 1200 K. THz observations require excellent weather conditions (PWV <0.2 mm). During period 86, such exceptional conditions are statistically expected to occur only during the August and October ESO runs. APEX-T2 proposals should therefore be very short and concentrate on bright sources.

Further information on the SHFI receivers can be found on the **APEX instrumentation pages**. As back-end, the Fast Fourier Transform Spectrometer (FFTS) has two units with a fixed bandwidth of 1 GHz, of which the central 900 MHz are usable. This allows users to cover up to 1.8 GHz instantaneous bandwidth. The two FFTS units can also be individually configured to cover two regions of 900 MHz within the 4 GHz IF bandwidth of SHFI. Spectral resolutions ranging from 976.56 ($\sim$0.92 km s^{-1}) to 122.07 kHz ($\sim$0.12 km s^{-1}) can be selected. For exposure time calculations, users should use the **SHFI observing time calculator.** Note that the time needed to search for an appropriate off-source position in extended line-emitting regions is *not* included. SHFI users wishing to map extended line-emitting regions should either provide an appropriate off-source position, or request additional observing time in the technical justification section to search for such a position. The overhead for this amounts to $\sim$30 min per field.

7.2 LABOCA, the Large APEX Bolometer Camera

LABOCA is a 295 channel bolometer array, operating in the 870 μm atmospheric window, with a beam size of 18.6$\pm$1″ and a total field of view of 11.4′. The instrument was commissioned in May 2007.

An overview of the instrument is given on the APEX home page:
www.apex-telescope.org/bolometer/laboca/.

As the beam switching mode using the wobbling secondary has not been commissioned yet, we will only offer the continuous integration modes during Period 86. Proposals that would benefit from using the wobbler (e.g. flux determinations of single sources) may mention this in the technical description (Box 9 of the proposal form). If the beam switching mode is available at the time of the observations, this mode may be used. However, integration time calculations should be based only on the compact mapping mode given by the observing time calculator.

The following observing patterns will be offered:

- Spiral mode;
- Raster map in spiral mode;
- On-The-Fly mapping (OTF).

The main advantages of the spiral modes are that (1) the scanned area is only slightly larger than the LABOCA field of view, leading to a maximum of integrations on the central 11′ field of view, and (2) the overheads by the telescope control system are much smaller, as the spirals use a continuous data taking mode while there is a “dead” time when the telescope turns at the edges of the OTF maps. The optimal observing pattern depends on the spatial extent of the source to be imaged. Recommendations are provided on the APEX home page:
www.apex-telescope.org/bolometer/laboca/observing/.

For integration time calculations, users should assume the following values: Noise Equivalent Flux Density (NEFD)=120 mJy$\sqrt{s}$ and 248 working bolometers. For point source detection experiments, one can apply a low frequency sky noise filtering, improving the sensitivity to NEFD$\sim$75 mJy$\sqrt{s}$.

All proposers should use the LABOCA observing time calculator, available from www.apex-telescope.org/bolometer/laboca/obscalc/.

All integration times calculated using the LABOCA observing time calculator should be multiplied by a **factor of 1.9** to account for overheads such as acquisition, software setup, telescope slewing and calibrations (skydip, pointing, focus and flux calibration). The LABOCA integration time calculator also provides the total time including this 90% overhead.

7.3 SABOCA, the Submillimetre APEX Bolometer Camera

SABOCA is a bolometer array operating in the atmospheric window at 350 μm (855 GHz). SABOCA consists of an array of 39 superconducting TES (Transition Edge Sensor) thermistors with SQUID (Superconducting Quantum Interference Device) amplification and multiplexing. Of these, 37 are arranged in a hexagonal layout consisting of a center channel and 3 concentric hexagons (one channel is known to be broken). Two additional bolometers, identical to the inner 37 but optically not coupled (called blind bolometers) were added to the layout at two diametral opposite positions, for monitoring purposes. The bolometers are designed to be operated at a temperature of about 300 mK, provided by a cryostat using liquid nitrogen and helium, in combination with a close-cycle helium-3 sorption cooler.

The APEX beam size at this wavelength is 7.7″, and the total field of view for SABOCA is 90″. The array is undersampled on the sky; the separation between channels is twice the beam size (15″). To obtain fully sampled maps it is necessary to move the array on the sky during observations by scanning in one direction and then stepping in the other, or by moving in a circular or spiral pattern in the telescope or astronomical coordinate system.

As the beam switching mode using the wobbling secondary has not been commissioned yet, we will only offer the continuous integration modes during Period 86. Proposals which would benefit from using the wobbler (e.g. flux determinations of single sources) may mention this in the technical description (Box 9 of the proposal form). If the beam switching mode is available at the time of the observations, this mode may be used. However, integration times should be based only on the compact mapping mode given by the observing time calculator.

Exposure time estimates should assume a noise equivalent flux density, NEFD = 200 Jy s$^{1/2}$, weather conditions of PWV=0.5mm, 37 working bolometers and a 90% overhead for slewing, pointing, focus and calibrations. A dedicated SABOCA integration time calculator is available at http://www.apex-telescope.org/bolometer/saboca/obscalc/.

7.4 APEX-SZ, the APEX Sunyaev-Zel'dovich camera

The MPIfR/Berkeley PI instrument APEX-SZ is a bolometer array operating at 152±23 GHz (2 mm). It is optimised for surveys of the Sunyaev-Zel'dovich effect in distant clusters, but can also be used for other studies. APEX-SZ consists of an array of 330 superconducting TES (Transition Edge Sensor) thermistors with SQUID (Superconducting Quantum Interference Device) multiplexers. There are 330 channels in the focal plane, of which 232 can be read out reliably, with a typical NEP of 10^{-16} W Hz^{-1}. Typically, 160 low-noise channels are used for mapping.

The APEX beam at this wavelength is 59″, and the total field of view for APEX-SZ is 23′.

The standard observing mode for clusters are raster scans, which reach a central map rms of 75 μK (CMB) in 1 hour of observing time. The alternative observing mode are circle drifts, which are smaller and thus have higher central coverage, but do not allow as much skynoise filtering to be applied. This mode obtains and rms of 60 μK. All observing time estimates should assume the above sensitivities and a 90% overhead for slewing, pointing, focus and calibrations.

As the operation of the APEX-SZ instrument requires the presence of the instrument team, all APEX-SZ observations from the different APEX partners will be scheduled in a joint observing block. The exact dates of operation for 2010 have not been determined yet, but it is likely to be during November. Time critical observations using APEX-SZ are therefore very difficult to schedule.

Proposers interested in using APEX-SZ should include a coI from the instrument

team and should contact Dr. Adrian Lee (Adrian.Lee[AT]berkeley.edu) at least 1 week prior to submission of a proposal. Further information on APEX-SZ can be found on the **APEX-SZ homepage**. Technical questions should be direct ed to the ESO APEX Project Scientist, Dr. Carlos De Breuck (cdebreuc[AT]eso.org).

7.5 CHAMP+: The Carbon Heterodyne Array of the MPIfR

CHAMP+ is a MPIfR PI instrument which is offered to the ESO community on a collaborative basis with MPIfR. CHAMP+ is a heterodyne array operating simultaneously in the 350 μm and 450 μm atmospheric windows. It is composed of 14 pixels, divided into two sub-arrays of 7-pixels each, arranged in a hexagonal configuration. The two sub-arrays operate at orthogonal signal polarizations. The RF tuning range is 620-720 GHz for the 450 μm and 780-900 GHz for the 350 μm sub-array.

The beam-spacing is 2.15 times the half-power beam widths of 8.8″(at 692 GHz) and 7.7″(806 GHz), so only the central pixels of the two sub-arrays are spatially co-aligned on sky. The front-end is connected to a FFT spectrometer array back-end, providing up to 2.8 GHz of bandwidth for each detector pixel, with spectral resolution of 212 kHz. The system is operated in single-sideband mode. For exposure time calculations, users should assume SSB system temperatures of typically 1000–1400 K (at the frequency of the CO(6-5) line at 691 GHz) and 2500–4000 K (CO(7-6) at 806 GHz, closer to the edge of the atmospheric window). The image gain suppression is better than 10-15 dB for all pixels (in the centre of the IF band). All CHAMP+ proposals should add a 20% additional overhead for instrument characterisation and calibration purposes such as the establishment of a pointing model and the determination of the gain curves.

Further information on CHAMP+ can be found in the **CHAMP+ homepage**.

As the operation of CHAMP+ requires the presence of the instrument team, all ESO CHAMP+ observations will be scheduled on fixed dates. The exact dates of operation for 2010 have not been determined yet, but they are likely to be in the early part of the period, when the atmospheric transparency is expected to be better. Time critical observations using CHAMP+ are therefore very difficult to schedule.

Users who would like to use CHAMP+ should contact the PI, Dr. Rolf Guesten (rguesten[AT]mpifr-bonn.mpg.de) at least two weeks prior to submitting the proposal for which they are requesting approval. Members of the PI team that will operate the instrument for the guest proposal shall be included as CoIs on the proposal.

8 Visitor Instruments

Visitor instruments can be mounted at the VLT (UT1), the VLTI, the NTT, the 3.6-m telescope and at APEX in order to permit innovative observations by teams with their stand-alone instruments or to test new instrumental concepts for the development of new facility instruments. The requirements for visitor instruments are substantially reduced compared to the requirements for fully integrated facility instruments. A set of guidelines on how to propose and carry out visitor-instrument observations is found at
http://www.eso.org/sci/facilities/paranal/instruments/visfocus/. No Visitor Instrument focus will be available on the VLT starting from Period 88, when KMOS will be commissioned.

As of Period P84, the VLT Visitor Focus is located at the Nasmyth B focus of UT1 (Antu). For technical information concerning the interface between an instrument and the VLT Visitor Focus please consult
http://www.eso.org/sci/facilities/paranal/instruments/visfocus/requirements.html.

A comparable set of guidelines on how to propose a visitor instrument on the VLTI is available at
http://www.eso.org/sci/facilities/paranal/instruments/vlti-visitor/.

Technical information on the interface for VLTI Visitor Instruments can be found at
http://www.eso.org/sci/facilities/paranal/instruments/vlti-visitor/requirements.html.

Technical information on the interface to the NTT and 3.6-m telescope is found at URL
http://www.eso.org/sci/facilities/lasilla/instruments/visitor/VisitorInstruments.pdf.

9 How to estimate overheads

Service and Visitor Mode observers **must** include the overhead times associated with their science target observations in their proposals. In Service Mode observations, the total execution time must include all overheads, from telescope pre-setting, to target acquisition and to all other relevant instrument overheads, for every planned Observation Block. In order to fulfil the 1 h OB rule, proposers should note that all overheads must be accounted for within this one hour. Also in Service Mode, time for night-time calibrations and associated overheads should be included only in cases where the accuracy of the calibration plan is not deemed sufficient for the science goals. Please note that calibrations need to be executed as part of the science OBs in some instrument modes (e.g. attached calibrations for VIMOS IFU and some MOS modes; see the VIMOS User Manual for details). The time needed to execute such attached calibrations needs to be included in the proposal; see Section 10.2. As a guideline to help proposers estimate the overheads associated with their observations, we provide "typical" numbers in Table 19. More details can be found in the instrument manuals.

Proposers are strongly encouraged to make use of the **Phase 2 Preparation Tool (P2PP)** during the preparation of their proposals in order to accurately determine the overheads required by their programmes. It is possible to simulate the detailed breakdown of the programme in terms of its constituent Observation Blocks (OBs) using the P2PP tutorial accounts:
http://www.eso.org/sci/observing/phase2/P2PP/P2PPDocumentation.html.
The Execution Time Report option offered by P2PP then provides an accurate estimate of the time needed for the execution of each OB, including all the necessary overheads. Service Mode proposers should take into account that the total execution time estimated by P2PP reflects the official ESO time accounting in Service Mode.

10 Calibration Plans and Pipelines

10.1 Data Quality Control

ESO has implemented **calibration plans** for all instruments. The primary purposes of these plans are to assure data quality, monitor instrument performance and calibrate science observations. Based on these plans, calibration data are obtained for certain standard instrument modes on a regular basis. Paranal calibration data are reviewed on a daily basis by Paranal Science Operations and the Garching Data Processing and Quality Control group. A brief summary of the calibration plan for each instrument is available on-line from **http://www.eso.org/qc/pipeline-status.html**.

10.2 Calibration Plans and Calibration of Science Observations

The typical target accuracy of the calibrations plans to calibrate science data is 5–10%. This may not be sufficient for all science programmes. **Important:** not all instrument modes and/or configurations are covered by the current calibration plans. Read the appropriate user manual and online documentation carefully (**http://www.eso.org/qc/pipeline-status.html**).

Daytime calibrations included in the calibration plans (e.g. bias, flat-fields, and arc-lamp exposures) are performed by the Observatory for both Service and Visitor Mode runs. Whenever possible, these data are obtained in the morning immediately after night-time operations conclude. Service and Visitor Mode users receive these data automatically.

For **Service Mode runs**, certain ESO specified night-time calibrations (e.g. photometric standard stars, telluric absorption correction stars) are obtained systematically as described by the calibration plan in the instrument-specific user manuals. For many programmes, these calibrations may be

Table 19: Telescope and Instrument Overheads

Hardware item	Action	Time (minutes)
La Silla telescopes	**Preset (point and acquire target)**	**4**
La Silla telescopes	**Preset (NTT with image analysis)**	**6**
HARPS	Read-out	1
SOFI	Imaging	∼30% of total int. time
SOFI	Spectroscopy	∼35% of total int. time
EFOSC-2	Read-out	2
FEROS	Read-out	2
WFI	Move to gap/pixel	7
WFI	Template change (with initial offset $\leq 120''$)	0.5
WFI	Template change (with initial offset $> 120''$)	1
WFI	Filter change	1
WFI	Offset + readout	1.17
Paranal telescopes	**Preset**	**6**
FORS2	Acquisition (1 cycle w/o exp. time)[1]	1.5 or 2
FORS2	Through Slit Image (2 cycles w/o exp. times)[2]	4
FORS2	Instrument Setup	1
FORS2	Retarder Plate Setup per PMOS/IPOL OB	1
FORS2	Read-out 100kHz binned (spectroscopy)	0.7
FORS2	Read-out 200kHz binned (imaging)	0.5
CRIRES	Acquisition without AO	3
CRIRES	Acquisition with AO	5
CRIRES	Read–out	10%–60% exposure time[3]
CRIRES	Nodding cycle	0.4
CRIRES	Change of wavelength setting	1.4 – 2.4 [3]
CRIRES	Change of derotator position angle	1
CRIRES	Attached wavelength calibration	2.5
CRIRES	Attached lamp flat	2

[1] Typically one cycle for the target acquisition (exposure time of the acquisition image not included). MXU, MOS, and PMOS: 2 min. LSS,IPOL,ECH: 1.5 min (per cycle). IMG none.

[2] Through-slit exposures are mandatory for all spectroscopic OBs. Two cycles are typically enough to centre the target on the slit (exposure time of the through slit image not included). MXU,MOS,PMOS,LSS,ECH 2.0 min (per cycle), IMG and IPOL none.

[3] See CRIRES User's Manual for more detail.

Table 19: Telescope and Instruments Overheads (continued)

Hardware item	Action	Time (minutes)
ISAAC[4]	Instrument Setup, Imaging	0.5
ISAAC	Instrument Setup, Spectroscopy (incl. slit check)	7
ISAAC	Telescope Offsetting	0.25
ISAAC	Target Acquisition	1–4
ISAACHw	Read-out (per DIT, imaging)	0.07
ISAACAl	Read-out (per DIT, imaging without chopping)[5]	negligible
ISAACHw	Read-out (per DIT, spectroscopy)	0.13
ISAACAl	Read-out (per DIT, spectroscopy without chopping)[6]	negligible
ISAACAl	Imaging with chopping	40%[7]
ISAACAl	Spectroscopy with chopping	30%[7]
ISAAC	Night-time flat[8] (one on-off pair)	4
ISAAC	Night-time arc[8] (one on-off pair)	3
ISAAC	Burst and FastJitter Modes	See the **Burst** web page
UVES	Instrument Setup	1
UVES	Acquisition. Bright Point Source	2
UVES	Acquisition. Faint, Extended or Crowded Field	5
UVES	Read-out[9], 1×1, Fast	0.75
UVES	Read-out[9], 2×2, Slow	0.75
UVES	Attached ThAr, Night-time	1.5
UVES	Attached Flat, Night-time	2
XSHOOTER	Target acquisition	3-5
XSHOOTER	Telescope offsetting	0.25
XSHOOTER	Instrument setup Slit	0.5
XSHOOTER	Instrument setup IFU	1
XSHOOTER	UVB Read-out[12], 1×1, Slow/Fast	70 / 19 sec
XSHOOTER	UVB Read-out[12], 1×2, Slow/Fast	38 / 12 sec
XSHOOTER	UVB Read-out[12], 2×2, Slow/Fast	22 / 8 sec
XSHOOTER	VIS Read-out[12], 1×1, Slow/Fast	92 / 24 sec
XSHOOTER	VIS Read-out[12], 1×2, Slow/Fast	48 / 14 sec
XSHOOTER	VIS Read-out[12], 2×2, Slow/Fast	27 / 9 sec
XSHOOTER	NIR Read-out (per DIT)	0.88 sec
NACO	see Users' Manual	—
VIMOS	IMG acquisition + Instrument setup	3
VIMOS	MOS acquisition + Instrument setup	15
VIMOS	IFU acquisition + Instrument setup	10
VIMOS	Read-out IMG,MOS,IFU (4 quadrants)	1
VIMOS	Change of Filter (IMG)	3
VIMOS	Attached screen flat+arc (IFU, MOS)[10]	5-8
VIMOS	Attached arc (MOS)[11]	4

[4] ISAAC refers to both Aladdin and Hawaii, ISAACHw only to Hawaii detector, ISAACAl only to Aladdin detector.

[5] For the Aladdin SW J+Block,H,K and LW low background NB_3.21 and NB_3.28 filters only.

[6] In Medium Resolution (MR) only.

[7] Global overheads in % are used for the LW imaging and spectroscopic chopping templates.

[8] When required, see **http://www.eso.org/sci/observing/phase2/CalibrationPlan.html** and the ISAAC user manual.

[9] In a dichroic exposure the CCDs are read out in parallel.

[10] Flat and arcs are mandatory for IFU.

[11] Arcs are mandatory for MOS blue settings and strongly recommended for the MOS red settings.

[12] The detectors are read sequentially; see User Manual for details.

Table 19: Telescope and Instruments Overheads (continued)

Hardware item	Action	Time (minutes)
FLAMES	Acquisition[13]	9
FLAMES	Instr. Setup GIRAFFE	1
FLAMES	Instr. Setup UVES	1
FLAMES	CCD read-out GIRAFFE	1
FLAMES	CCD read-out UVES	1
FLAMES	Screen Flatfields	7
FLAMES	Plate Configuration[14]	0–20
VISIR	Imaging target acquisition (incl. setup):	
VISIR	fine acquisition (>1 Jy source)	5
VISIR	blind preset (<1 Jy source)	2
VISIR	Imaging read-out/chopping	50% of int.time
VISIR	Burst read-out/nod-chopping	80% of int.time
VISIR	Spectroscopy target acquisition (incl. setup):	
VISIR	>1 Jy source	15
VISIR	0.2–1 Jy source	30
VISIR	Spectroscopy read-out/nod-chopping	50% of int.time
SINFONI	Acquisition no AO	3
SINFONI	Acquisition AO (NGS)	$2+4*(\mathrm{DIT}*\mathrm{NDIT})$[15]
SINFONI	Acquisition AO (LGS)	$9+4*(\mathrm{DIT}*\mathrm{NDIT})$[15]
SINFONI	Acquisition target (AO and no AO)	$4+4*(\mathrm{DIT}*\mathrm{NDIT})$
SINFONI	Instrument setup (per grating change)	2.5
SINFONI	Science exposure read-out (per DIT)	0.07
SINFONI	Detector setup (per DIT×NDIT)	0.3
HAWK-I	Target Acquisition and Instrument Setup	1
HAWK-I	Target Acquisition (MoveToPixel) and Instrument Setup	3
HAWK-I	Telescope Offset (large)	0.50
HAWK-I	Telescope Offset (small)	0.15
HAWK-I	Read-out (per DIT)	0.03
HAWK-I	Filter change	0.35
MIDI	One calibrated Visibility SCI-CAL[16]	60
MIDI	One calibrated Visibility CAL-SCI-CAL[16]	90
AMBER	One calibrated Visibility CAL-SCI-CAL in LR[16]	$30+45*$(number of bands)[17]
AMBER	One calibrated Visibility CAL-SCI-CAL in MR or HR[16]	$45+45*$(number of bands)[17]
AMBER	One calibrated Visibility SCI-CAL in LR[16]	$20+30*$(number of bands)[17]
AMBER	One calibrated Visibility SCI-CAL in MR or HR[16]	$30+30*$(number of bands)[17]

[13] Includes configuration of UVES fibres, homing the rotator to 0∘, swapping of the plates, and the acquisition of field; telescope preset, acquisition of the guide star, and start of the active optics are not included and account for additional 6 minutes. For ARGUS fast acquisition (Visitor Mode only), the acquisition overhead is 2 minutes and is calculated assuming that plate 2 is already attached to the telescope.

[14] Plate configuration takes 20 minutes at most (Medusa fibres). This does not translate into additional overheads if the running exposure on the other plate is at least 20 minutes long. Plate configuration overheads have to be added if the exposure time is shorter than 20 minutes.

[15] here: DIT and NDIT as required for the AO natural guide star (NGS).

[16] This time includes all telescope and instrument overheads **as well as** the integration times on the science target **and** the calibrator.

[17] With a maximum number of 3 bands per wavelength setting. For each new wavelength setting, a new calibrated visibility has to be obtained.

sufficient. In this case, Service Mode proposers should only request enough time to complete their science observations. *If the published calibration plan is not sufficient, Service Mode proposers must request more time (including all operational overheads) for additional user-defined calibrations.*

Please note that ESO further accepts Calibration Programmes to achieve improved calibration of its instruments (see Sect. 11.6 for details).

Important note: for some instruments and modes, calibrations need to be obtained immediately after the science observation and as a part of the same OB, by means of attached calibration templates. Such attached calibrations that are an integral part of the science OB are not considered as a part of the calibration plan, and their execution time must therefore be included in the time applied for.

For **Visitor Mode runs**, night-time calibrations are the responsibility of the visiting observer, with the following exception: up to approximately 30 minutes per night will be used by the observatory staff to obtain standard ESO calibration data. The ESO-obtained data will be used to monitor instrument performance and to assure a baseline calibration accuracy within the ESO Science Archive for data obtained during this night. ESO does not guarantee that these standard calibration data will be sufficient to calibrate the Visitor Mode science observations to the accuracy desired by the observer. Visitor Mode proposers should plan accordingly.

ESO-obtained calibration data are made available automatically to both Visitor and Service Mode users as part of their end-of-run data package. All users receive the relevant raw data. In addition, Service Mode users may also receive master calibration data (e.g. combined stacks of bias frames, reduced flat-fields, wavelength dispersion solutions), depending on the instrument configuration and pipeline availability.

Important note for La Silla users: It is the responsibility of the Visiting Astronomer to obtain all nighttime and daytime calibration frames required. Although ESO staff will execute standard day calibration sequences and make them available to the visitor, all afternoon calibrations and sky flat-fields must be obtained by the visitor.

10.3 Data Reduction Pipelines

10.3.1 Data Organization: Gasgano and SAFT

Gasgano, a Java-based data file organizer developed and maintained by ESO, is made available to the community and can be used to manage and organize the astronomical data observed and produced by all VLT compliant telescopes in a systematic way. Gasgano can be retrieved from **http://www.eso.org/sci/data-processing/software/gasgano/**.

It is also possible to build Unix shell scripts for data organisation using the Stand-Alone FITS Tools (SAFT) available from **http://archive.eso.org/saft**. In particular, the dfits and fitsort tools can be used in combination to select groups of related files (*i.e.*, all frames with the same instrument configuration) for processing.

SAFT, and in particular the hierarch28 tool, can be effectively used to elegantly handle ESO HIERARCH keywords, e.g. convert them for use with other packages like IRAF.

In collaboration with the various instrument consortia, ESO has undertaken to implement data reduction pipelines for the most commonly used VLT/VLTI instrument modes. These data reduction pipelines serve three main purposes:

- **Data quality control** — pipelines are used to produce the quantitative information necessary to monitor instrument performance (see below).
- **Master calibration product creation** — pipelines are used to produce master calibration products (e.g. combined bias frames, super-flats, wavelength dispersion solutions).
- **Science product creation** — using pipeline-generated master calibration products, science products are produced by the Data Processing and Quality Control group in Garching for supported instrument modes (e.g. combined ISAAC jitter stacks; bias-corrected, flat-fielded

FORS images; wavelength-calibrated UVES spectra). The accuracy of the science products can be limited both by the quality of the available master calibration products and by the algorithmic implementation of the pipelines themselves. In particular, adopted reduction strategies may not be suitable for all scientific goals. Therefore, ESO assumes no responsibility for the usefulness of reduced data for any specific scientific project.

Pipelines can also be run on the end user's desktop in order to fine-tune the reduction to specific science needs. For this purpose, the algorithmic part of the VLT/VLTI pipelines (pipeline recipes) are available for home use and can be downloaded with two front-end applications (esoRex and Gasgano) from **http://www.eso.org/pipelines**.

A brief summary of current and anticipated VLT/VLTI pipeline availability and functionality for each instrument is available on-line from
http://www.eso.org/qc/pipeline-status.html.

10.3.2 Pipelines in the ESO Environment

Available pipelines are installed on Paranal and La Silla, and normally run automatically at all times (only HARPS, FEROS, and SofI have pipelines at La Silla). These **on-line pipelines** use recent (but typically not the most recent) archival master calibration data to produce quick-look QC information for the Observatory staff, as well as quick-look science products for supported instrument configurations. These science products are available to Visitor Mode observers for review and use as they wish. With the exception of HARPS and FEROS, they are **not** included in the data package delivered to the Visitor Mode observer at the end of their observing run. If they wish, users may copy these science products onto removable media (CD-ROM and DVD). Blank media are available from the Observatory for this purpose. However, these science products may not be the best possible because they do not use the most recent master calibration data.

The Garching-based **off-line pipelines** for VLT/VLTI instruments do use the best available and certified (quality-checked) master calibration products during Service Mode science product creation. The Garching master calibration products are created from the daily calibration data-stream and then used to process science data acquired during the same time interval. Service Mode users can access their pipeline science data products for supported instrument modes during the period via the User Portal. Master calibration products produced in Garching are ingested into the ESO Science Archive and can be requested for some instruments together with raw science by all users.

10.4 Quality Control

As mentioned above, the ESO pipelines are used to monitor the performance of the various instruments and their temporal trends.

Extensive information about Paranal data handling and processing, including instrument specific quality control parameters (e.g. zero-points, colour terms, wavelength solutions) are maintained on **the ESO Quality Control Web pages**. These pages provide information and data about actual instrument performance since the start of VLT operations. Corresponding La Silla calibration data are reviewed by La Silla Science Operations and used for instrument health checks. The trends are available from the web pages of the respective instruments.

10.5 The ESO Science Data Products Forum

The **ESO Science Data Products Forum** is a platform for sharing ideas, methods, software and data to assist with the production of science data products from ESO telescopes. The forum is a service for the ESO community. Contributions are by general users of the ESO instruments.

Users are encouraged to contribute about any topic related to the reduction, calibration and analysis of science data from ESO instruments. Posts might simply describe problems encountered with the data reduction, or offer solutions to such problems. Software, calibration data or documents up to 100MB in size can be attached to any post.

Part III

Proposal Types, Policies, and Procedures

11 Proposal Types

For Period 86 the list of proposal types is:

- Proposals for Normal Programmes,
- Proposals for Short Programmes,
- Proposals for Large Programmes,
- Target of Opportunity Proposals,
- Guaranteed Time Observation Proposals,
- Proposals for Calibration Programmes.
- Director's Discretionary Time Proposals,

Proposals for all of those categories must be submitted by the current deadline, except proposals for Director's Discretionary Time (DDT) which may be submitted at any time.

An observing programme, as described in a single proposal, may consist of several runs, e.g. for observations with different instruments, or to be executed in different observing modes or at different epochs. Proposals for *Visitor Mode* observations (Sect. 12.1) must request time in nights, proposals for *Service Mode* observations (Sect. 12.2) must request time in hours. Note that any given proposal may request a mix of Visitor/Service Mode observations provided that they are split into separate runs.

- **Please note:** All proposers (Service and Visitor Mode) must include time for all overheads (telescope + instrument) in their proposals (see Sect. 9).

11.1 Proposals for Normal Programmes

The largest fraction of ESO observing time in Period 86 is foreseen to be allocated to Normal Programmes. Proposers must use the standard LaTeX template (Sect. 3.1). In this template the proposer may use a total of two pages (not including figures) for the five sections:

```
A) Scientific Rationale
B) Immediate Objective
C) Telescope Justification
D) Observing Mode Justification (Visitor or Service)
E) Strategy for Data Reduction and Analysis
```

An additional 2 pages of attachments (for inclusion of figures or tables) is permitted. Proposals for Normal Programmes must be used only when the total amount of requested telescope time, summed over all the individual runs, is greater than 10 hours. If the total amount of requested time, summed over all runs, is less than or equal to 10 hours, the proposal form for Short Programmes **must** be used (see Sect. 11.2).

If the programme contains Visitor Mode runs, the total amount of requested time must be computed after the conversion of these runs from nights to hours. For Period 86, 1 night is taken to be equivalent to 8 hours.

If the proposal contains runs requesting La Silla telescopes and instruments, the duration of each such run must be greater than or equal to 3 nights, except for runs using Visitor Instruments or for combinations of contiguous EFOSC-2 and SOFI runs totalling at least 3 nights (see Sect. 4.1).

11.2 Proposals for Short Programmes

Short Programmes are similar to Normal Programmes, except that the total amount of time required to complete them (summed over all their runs) is less than or equal to 10 hours. For the conversion between hours in Service Mode and nights in Visitor Mode see Sect. 11.1. When applying for a Short Programme, proposers **must** use the LaTeX template for Short Programmes. In this template, the proposers may use a total of one page (not including figures) for the five sections:

```
A) Scientific Rationale
B) Immediate Objective
C) Telescope Justification
D) Observing Mode Justification (Visitor or Service)
E) Strategy for Data Reduction and Analysis
```

One additional page of attachments (for inclusion of figures or tables) is permitted. Proposals for Short Programmes are evaluated by the OPC on the same basis as Proposals for Normal Programmes, and a single merged ranking is established for both types of proposals.

11.3 Proposals for Large Programmes

Up to a maximum of 30% of the observing time distributed by the OPC on the VLT/VLTI can be allocated to Large Programmes. Proposals for Large Programmes may also be submitted for APEX; they are encouraged for the 3.6-m telescope and the NTT. The definition of an ESO Large Programme is as follows:

- a programme requiring a minimum of 100 hours of ESO telescope time, spread over a maximum of two years (four years for La Silla);
- a programme that has the potential to lead to a major advance or breakthrough in the field of study, has a strong scientific justification, and a plan for a quick and comprehensive effort of data reduction and analysis by a dedicated team;
- not a ToO programme (see Sect. 11.4).

A good organizational structure of the proposing team, availability of resources and relevant expertise must be demonstrated. A special LaTeX template must be used for Large Programmes (Sect. 3.1). Because of the extra requirements on the Large Programme proposals, the proposers may use a total of three pages (not including figures) for the four sections:

```
A) Scientific Rationale
B) Immediate Objective
C) Telescope Justification
D) Observing Mode Justification (Visitor or Service)
```

An additional 2 pages of attachments are permitted. Proposers of Large Programmes should keep in mind that **the entire OPC** (hence also non-experts in a specific field) as well as the specialised OPC panels will be evaluating their proposal, and that **they should clearly explain the relevance of the proposed programme to general astrophysics**.

If a Large Programme proposal contains runs requesting La Silla telescopes and instruments, the duration of each such run must be greater than or equal to 3 nights.

Contrary to previous periods, Large Programmes can **no longer** be converted to Normal Programmes.

Proposers should be aware that the PIs of successful proposals for Large Programmes are required to provide all data products (processed images and spectra, catalogues) to the ESO archive by the time their scientific results are published in a refereed journal. Guidelines for submission of these data products, including a description of the required metadata and formats, can be found at **http://archive.eso.org/cms/eso-data/data-submission/**. For further information, proposers are invited to write an email to **usd-help@eso.org**.

During the period of execution of a Large Programme, and upon its completion, the PI will be invited by ESO to report to the OPC on the programme's preliminary results. He/she may also be asked to give a more comprehensive presentation of the outcome of the programme at an ESO Large Programme workshop, similar to those of **May 19-21, 2003** and of **October 13-15, 2008**.

11.3.1 ESO/GTC proposals for Large Programmes

The accession agreement of Spain into ESO includes the allocation of 122 clear nights with the 10.4 m GTC to proposals by PIs from ESO member countries (including Spain). This is the third and final call for ESO/GTC proposals.

The ESO/GTC programmes must satisfy the following conditions:

- Each programme should request a minimum of 10 nights.
- Of the order of 50 nights will be scheduled during the last year of ESO/GTC programmes.
- The observations will be conducted in either Service Mode or Visitor Mode by the proposing teams according to the standard GTC operational procedures.

Within these constraints, the ESO/GTC liaison committee, which oversees the execution of the programme, has established the following:

- In this final call, ESO/GTC proposals are invited for Large Programmes to be observed between 1 March 2011 and 29 February 2012.
- The available instruments are:
  1. **OSIRIS** – the optical imager and multi-object spectrograph – in the following modes: broad band imaging, narrow band imaging with the red tunable filter, long slit spectroscopy and fast detector read out mode;
  2. **CanariCam** – the mid-IR imager-spectro-polarimeter – in the following modes: imaging, spectroscopy and polarimetry.

  The above links contain the information to be used for proposal preparation, including the exposure time calculators.
- The mechanism for submission and evaluation of ESO/GTC proposals is the same as for ESO Large Programmes.
- For this last call, as for the two previous calls, the technical feasibility of the proposals by the GTC will be done after the evaluation by the OPC, but well ahead of the start of observations. Thus, PIs will be informed of any changes in the foreseen performance with sufficient anticipation to allow them to revise their observing strategy, if needed.
- The ESO rules for Guaranteed Time Observations (GTO) will apply to the ESO/GTC programmes recommended by the OPC.
- GTO programmes from the instrumentation teams will have priority over ESO/GTC proposals. In order to avoid duplication, the abstracts and lists of targets from these GTO teams are accessible via the **OSIRIS** and **CanariCam** web pages and should be read by the prospective applicants to avoid duplication. Correspondingly, the abstracts and lists of targets from approved ESO/GTC proposals will be made public through the ESO web-pages at least one month before the deadline for submission of normal GTC proposals.

ESO/GTC observations will be executed either in service or visitor mode. However, clear nights are guaranteed as per the Agreement, so applicants should apply for the exact amount of time required to complete the programme before March 2012. Since for service mode observations the requested time must be specified in hours rather than in nights, the minimum duration of ESO/GTC service mode programmes will be 90 hours.

ESO/GTC proposals must be submitted using the ESO LaTeX template for Large Programmes. Note however that the version of this template to be used in this case is different from that for the ESO telescopes, and is available as part of a special ESOFORM package (cycle 86B). This package can be obtained as explained in Sect. 3.1.

11.4 Target of Opportunity Proposals

Normally, up to 5% of the available ESO general observing time may be used for *Target of Opportunity* (ToO) proposals. For events with exceptional characteristics ESO will also consider overriding Visitor Mode observations.

ESO recognizes two categories of Targets of Opportunity:

1. **Unpredictable ToOs** are those concerning unpredictable astronomical events which require immediate observations. The occurrence of such events cannot be foreseen with sufficient anticipation to allow them to be the subject of proposal submission by the regular, biannual deadline. They **qualify for allocation of Director Discretionary Time**. Corresponding applications for observing time should be submitted as DDT proposals (Sect. 11.7), not as ToO proposals.
2. **Predictable ToOs** are those concerning predictable events in a generic sense only. This is typically (but not limited to) known transient phenomena, and follow-up or coordinated observations of targets of special interest. Proposals aimed at studying such events are, in the ESO proposal terminology, ToO proposals.

ToO programmes may *only* be submitted using the Normal Programme ESOFORM template, by the same biannual deadline as Normal Programmes. Even if the total amount of requested time does not exceed 10 hours, the Normal Programme template should be used. Proposals should be for generic targets and/or times. However, if accepted by the OPC the programme will not be executed until the PI contacts ESO to request its activation after the predicted event has occurred. The observing strategy must be the one approved by the OPC and the amount of requested time may not exceed that granted by the OPC. The observations will be conducted in Service Mode and, in exceptional cases, ongoing programmes may be interrupted. Read more on **ToO policy**.

As ToO programmes may require a mixture of ToO runs and normal (see 3.2.1) runs, it is now possible to specify which runs are normal in the ESOFORM LaTeX template. Proposers are requested to specify which runs are of ToO type in the tenth (final) field of the `\ObservingRun` macro of the ESOFORM. A more detailed description and examples can be found in the ESOFORM Users' Manual.

Note that users submitting a ToO programme will need to indicate the number of targets per run and the requested number of triggers per target using the appropriate macros in the LaTeX template. A trigger is defined as the request for execution of one Observation Block with a given instrument at a given epoch. Similar observations to be executed with the same instrument at different epochs count as different triggers, as do observations with different instruments at the same epoch.

Any observing request by other groups at the time an event occurs (e.g., a DDT proposal), with exactly the same scientific goal and aiming at observing the same object, will be rejected by ESO except if it is a coordinated project in collaboration with the PI of the accepted ToO programme. ToO programmes are **not** carried over to the following periods.

ToO proposers should bear in mind that ToO proposals are ranked across OPC categories by the whole OPC (hence including non-experts in their specific field), they should therefore clearly explain the relevance of the proposed programme to general astrophysics.

11.4.1 Rapid Response Mode (RRM)

ESO continues to offer VLT Rapid Response Mode (RRM). During Period 86, FORS2 on UT1, UVES and XSHOOTER on UT2, ISAAC on UT3, and SINFONI and HAWK-I on UT4 are available in RRM.

RRM proposers should note that:

- A RRM trigger is a special ToO trigger that **can only be activated up to 4 hours after an event. After this deadline observations should be requested through normal ToO triggers.**
- As with ToO programmes, proposers will need to indicate in the LaTeX template the number of targets per run and the requested number of triggers per target.
- **RRM runs have to be specified as separate runs** in the ESOFORM template.

Upon receiving an encoded alert indicating the coordinates of the target and the associated Observing Block (OB) to be executed, any ongoing integration will automatically be terminated and the RRM OB will be executed. Depending on the instrument and the target position, the telescope/instrument will be at the location of the target within about 6 minutes following the arrival of the alert at Paranal. Depending on the target brightness and instrument mode, target acquisition may take some more time.

RRM observations in Period 86 are subject to the following restrictions:

- The requested instrument must already be in operation. No change of instrument (and telescope focus) is accepted by the automatic RRM system.
- RRM activations will be accepted during Service Mode and Visitor Mode runs. They have overriding priority over other observations, except if the latter are strictly time-critical.

Additionally, the following instrument specific restrictions apply:

- UVES can only be used with standard wavelength settings;
- ISAAC can only be used in the SW imaging and SW spectroscopic modes;
- FORS2 can only be used in the broad-band imaging, long slit spectroscopic, imaging polarimetric and spectro-polarimetric modes;
- SINFONI is available in NGS and noAO mode but not in LGS mode;
- HAWK-I: all the filters can be used, but the trigger requesters must follow the manual indications closely as far as brightness restrictions of objects in the field are concerned.

The delivery of the encoded alerts to the Paranal Observatory is entirely the responsibility of the PI. Successful PIs will be asked to provide a set of OBs by the Phase 2 deadline, to be certified for execution as is done for other Service Mode runs. Details on the activation mechanisms and the preparation of RRM observations can be found at
http://www.eso.org/sci/observing/phase2/RRMObservation.html.

11.5 Guaranteed Time Observations

Guaranteed Time Observations (GTO) arise from contractual obligations of ESO vis–à–vis the external consortia who build ESO instruments (see **http://www.eso.org/observing/proposals**). Guaranteed Time Observers must submit proposals for their GTO time using the standard templates, and by the standard proposal deadline. The Short Programme template should *not* be used, even if the total amount of requested time does not exceed 10 hours (the Normal Programme template should be used instead). All GTO proposals will be evaluated and ranked together with Normal Programme proposals to provide feedback to the GTO teams on the scientific standing of their GTO programmes.

In general, GTO runs must be conducted in Visitor Mode (Sect. 12.1). The only exceptions are those explicitly stated in the contractual agreement between ESO and the corresponding external consortium. However ESO may exceptionally transfer some GTO runs from Visitor Mode to Service Mode for operational reasons (such as the availability of VLTI baselines or the availability of the LGSF).

11.6 Proposals for Calibration Programmes

ESO operates a large number of complex instruments, with many possible configurations and observing modes. Although the Observatory executes a rigorous calibration plan for each instrument, ESO does not have the resources to fully calibrate all potential capabilities of all instruments. On the other hand, the astronomical community has expressed interest to perform calibrations for certain uncalibrated or poorly calibrated modes, or to develop specialized software for certain calibration and data reduction tasks. In recognition of this, ESO has introduced a new type of programmes, the Calibration Programmes, for which users are invited to submit proposals that aim at filling in some of the gaps in the existing coverage of the calibration of ESO instruments.

Up to 3% of all the available observing time may be made available for calibration proposals. Calibration Programmes will be evaluated by the OPC, with a view to balancing the added calibration value for future science with the more immediate return of the regular science proposals of the current period. The OPC is supported by a dedicated ESO internal calibration programme committee to review the technical and operational feasibility.

Successful proposers will be required to deliver documentation, and data products and software to ESO to support future observing programmes. The raw calibration data, as well as the advanced calibration products that are obtained as part of Calibration Programmes will be non-proprietary and made available to the entire community through the ESO archive, and the respective instrument Web pages. Scientific publications that take advantage, or make use of the data or results of Calibration Programmes, will have to reference the corresponding proposals.

Calibration Programmes must only be submitted using the LaTeX template for Normal Programmes. In particular, the Short Programme proposal template should not be used, even if the amount of requested time does not exceed 10 hours (the Normal Programme template should be used instead). In Box 8A (entitled "Scientific rationale") the proposers should clearly state the limits of the existing calibration plan and the expected improvement that can result from the proposed observations. Moreover the proposal should emphasise the relevance and the overall scientific gain of the calibration techniques and products resulting from these observations. Calibration Programmes do not pertain to any of the standard OPC categories (A, B, C or D), since in general they are not directly related to a unique scientific area: the special subcategory code L0 should be used to distinguish them. The PI of Calibration Programmes are required to deliver to ESO the resulting Advanced Data Products within one year of the completion of the corresponding observations. The procedure to be followed is described at **http://archive.eso.org/cms/eso-data/data-submission/**.

11.7 Director's Discretionary Time Proposals

Up to 5% of the available ESO general observing time may be used for *Director's Discretionary Time Proposals* (DDTs) in Period 86. Only DDT proposals belonging to one of the following categories will be considered:

- proposals of ToO nature requiring the immediate observation of a sudden and *unexpected* astronomical event,
- proposals requesting observations on a highly competitive scientific topic,
- proposals asking for follow-up observations of a programme recently conducted from ground-based and/or space facilities, where a quick implementation should provide break-through results,
- proposals of a somewhat risky nature requesting a small amount of observing time to test the feasibility of a programme.

DDT programmes that have target of opportunity runs should now mark their corresponding Run Types as "TOO" in the `\ObservingRun` macro. See the ESOFORM Users' Manual for more details. DDT programmes involving TOO runs should also fill in the `\TOORun` macros in the ESOFORM proposal template as instructed.

Approved DDT proposals are carried out in Service Mode on Paranal and Chajnantor, or in Visitor Mode override on La Silla. Very few non-time-critical DDT proposals are foreseen to be approved so proposers should provide a clear justification (in Box 8D of the application form) why the programme should be considered for DDT allocation and why it was not submitted through the normal OPC procedure. In the absence of such a justification, the proposal will not be considered for DDT allocation, and the proposers will be encouraged to resubmit their proposals for the next appropriate OPC submission deadline. *As a general rule, proposals originally submitted to the OPC that were not allocated time must not be submitted as DDT proposals.*

DDT proposals may be submitted at any time. They must be written using the special ESOFORM DDT template. Proposers must upload the DDT ESOFORM template and submit their DDT proposals by registering and logging into the User Portal. You can find more details at:

http://www.eso.org/sci/observing/proposals/esoform.html

DDT proposals are reviewed at ESO and approved by the Director General. Urgent requests must be clearly identified in Box 5 (Special Remarks) of the application form.

Please note: Within one month following the delivery of the data, the PI of an accepted DDT proposal must submit a report on the achieved science to **opo@eso.org**.

11.8 Non-member State Proposals

A *Non-member State Proposal* is a proposal where 2/3 or more of the proposers are not affiliated to ESO member state institutes independently of the nationality of the proposers and of the affiliation of the PI. Non-member state proposals are submitted in the usual way, but a separate set of criteria are used for the review of such proposals (Sect. 13.1). This non-member state policy does not apply to the host state, Chile, whose participation is regulated by the "Interpretative, Supplementary and Amending Agreement" to the 1963 Convention (Sects. 11.9 and 13.1).

11.9 Host State Proposals

Qualifying proposals whose PI is affiliated with an institute of the Host State (Chile) are counted as a *Host State Proposals*. The designation as *Host State Proposal* is independent of the fraction of non-member state CoI's.

12 Observing Modes

In Period 86, most VLT and VLTI instruments will be offered in two modes: *Visitor Mode* (VM) and *Service Mode* (SM). These modes have been extensively described in the Data Flow Operations section of the **December 1997** and **June 1998** issues of The ESO Messenger (see also an article on Service Mode scheduling in the **September 2001** issue). As part of the Phase 1 proposal, investigators will have to specify which mode they desire and why they request that mode. While it will be attempted as much as possible to follow the desire of the proposers with respect to observing mode, ESO does reserve the right to allocate time in a mode different from the one requested. Note especially the restrictions of available modes detailed in Sects. 12.1 and 12.2, and the policy in Sect. 13.3.

The telescope, as well as the instruments, will be operated by Observatory staff only. The astronomer interfaces with the telescope/instruments via Observation Blocks (OBs), produced using the Phase 2 Proposal Preparation (P2PP) tool; see
http://www.eso.org/sci/observing/phase2/P2PP/P2PPTool.html.

12.1 Visitor Mode

In *Visitor Mode* (VM) the astronomer is physically present at the observatory during the data acquisition. Each approved VM run will be allocated specific calendar nights. One of the programme

investigators will travel to the Observatory and execute the observations.

For all ESO instruments data acquisition will be done by executing Observation Blocks (OBs), *i.e.*, observing sequences specified by the astronomer which are based on templates provided by ESO. VM investigators will be encouraged to construct their OBs before arriving on the site. However, P2PP allows OBs to be constructed and/or modified in real-time at the telescope (with only the partial exception of VIMOS, see Sect. 6.7). Unless informed otherwise, VM investigators will be required to arrive on Paranal before the start of their observing run as follows: 24 hours for UVES, and 48 hours for all other instruments. On La Silla, Visiting Astronomers shall arrive 1 to 2 days before the start of the observations, and may leave the site up to 1 to 2 days after the end of their observing run, according to the transportation schedule (see **the La Silla Science Operations page**). Note that programmes must be executed as specified at Phase 1 and approved by the OPC. In case the observing conditions are not ideal (see Sect. 4.2.2) the proposer should prepare a backup/alternative programme to be executed in place of the primary programme. Such backup programmes must be approved by ESO prior to the observing run. The corresponding requests must be submitted via the web-based form available at **http://www.eso.org/sci/observing/phase2/ProgChange/**. In the absence of a backup programme, if the conditions prevent the execution of the observations intended for the Visiting Astronomer's primary programme, the telescope will be used by the Observatory for execution of Service Mode observations.

For Paranal instruments, proposers should request VM if their observing programme requires real-time decisions. Usage of VM should also be considered for those observations whose execution does not strongly benefit from the short-term scheduling flexibility allowed by Service Mode (see Sect. 12.2). For the La Silla instruments, only VM is offered. VM is not supported on APEX.

Please note that **VM proposers must include overheads** for all science exposures. Guidelines are provided in Sect. 9.

12.1.1 ToO programme execution during VM observations

VM observations may be interrupted by time-critical DDT or ToO programmes. As far as possible, the execution of observations for such programmes will be confined to scheduled Service Mode periods, which typically account for approximately 60% of the allocated time. Under exceptional circumstances, the Director of the Observatory may decide to interrupt VM runs to allow Service Mode observations.

12.2 Service Mode

Up to approximately 60% of the total time available for observations on Paranal will be carried out in Service Mode (SM). SM is also the only mode supported for APEX. Service Mode is not offered on La Silla.

Investigators awarded SM time will be required to specify their programme by submitting to ESO in advance a Phase 2 package, consisting of OBs, finding charts, and a Readme form. Observers intending to submit proposals to be executed in SM may find it useful to familiarize themselves with the Phase 2 Service Mode **procedures**. Once the OBs are completed, they will be submitted to ESO for verification and acceptance.

Accepted OBs will be executed by ESO staff based on their OPC recommended priority and a proper match between the requested and the actual observing conditions. An article about SM scheduling appeared in **The ESO Messenger (2001, v. 105, p. 18)**. The article helps proposers understand how they may optimize their use of this observing mode, and it should be considered compulsory reading for SM proposers. The interval between the completion of the run or of the period and the release of the SM data package to the PI is typically a few weeks, depending on the instrument mode and the data volume. SM PIs have direct access (via their personal User Portal account) to their own raw proprietary data as soon as the data is ingested in the ESO Archive. Pipeline reduced data products will also become available to PIs of the corresponding SM programmes shortly afterwards.

Please note that **SM proposers must include overheads** for all science exposures. Guidelines

are provided in Sect. 9.

ESO will absorb all time required to complete the calibration sequences to the level of accuracy foreseen in the calibration plan (see Sect. 10.2), as well as overheads associated with such calibrations. If those calibrations are not adequate, the SM proposer must include time for any additional calibrations including overheads.

For Paranal, in general, proposers should request SM if their planned observations demonstrably benefit from the short-term scheduling flexibility allowed by this mode, provided that their programmes can be fully pre-specified without requiring any real-time decisions. Proposers are especially encouraged to request Service Mode if their programme involves Target of Opportunity events or synoptic observing, or if they require the best observing conditions (which occur at unpredictable intervals). Further information on SM observing may be found in the **Service Mode Guidelines**.

12.2.1 Service Mode policies

To ensure the efficiency of SM observing, ESO has implemented a number of rules, procedures and limitations on Service Mode runs. Some of them need to be carefully taken into account at the time of preparing an application for SM observations and are summarized here. Please note that most of these items have important consequences on the way that execution overheads must be taken into account.

- **Some observing strategies cannot be supported in Service Mode**; in particular, real-time decisions about the sequencing of OBs, complex OB sequencing, or decisions based on the outcome of previously executed OBs (like adjustment of integration times or execution of some OBs instead of others).
- **Observation Blocks (OBs) are executed non-contiguously**. Since efficient SM operations require continuous flexibility to best match the OB constraints with actual observing conditions, OBs for a given run are normally scheduled non-contiguously. It is thus not possible to reduce acquisition overheads by requiring the sequential execution of OBs with the same target field.
- **Multi-mode, multi-configuration OBs are normally not permitted in SM**. Although multiple configurations within one OB may sometimes reduce overheads, scheduling and calibrating such OBs is extremely inefficient. Different configurations should thus be in different OBs.
- **OB Total Execution Time**. Proposers should make sure that all overheads, including telescope pre-setting and acquisition overheads (as specified in Table 19) have been properly accounted for.
- **OB execution times must be below 1 hour**. Long OBs are more difficult to schedule and execute within the specified constraints because of the unpredictable evolution of the observing conditions. For this reason, OBs taking more than one hour to execute are not normally accepted (with the exception of AMBER). Proposers are especially encouraged to plan for OBs substantially shorter than one hour if the execution conditions are particularly demanding, as the fulfilment of all the constraints during the entire execution time becomes more unlikely as the OB becomes longer.
- **Phase 1 constraints are binding**. ESO will not allow any change of constraints at Phase 2, since constraints play an essential role in determining the long-term scheduling of SM time. Substantial changes with respect to the times on target specified at Phase 1 will not be allowed at Phase 2.
- **Fulfilment of Phase 2 constraints:** ESO will consider an OB as successfully executed if all the conditions in the constraint set are fulfilled. OBs executed under conditions marginally outside constraints by no more than 10% of the specified value will not be scheduled for re-execution. Adaptive Optics-assisted observations with a Strehl ratio within 50% of the specified constraint will not be repeated. VLTI OBs executed marginally outside the specified LST intervals by no more than 30 min will not be scheduled for re-execution.

- **Programmes with linked time requirements:** SM is also intended to support programmes with special timing requirements. However, proposers planning such programmes should keep in mind that at most 60% of both bright and dark time is allocated to SM (on Paranal), and that observing conditions cannot be predicted when a time-series is started. This means that timing sequences that are extremely long and/or complex, timing links that are very restrictive, and time-series for observations requiring excellent observing conditions, are unlikely to be successfully completed. Therefore, all such proposals are reviewed for technical feasibility and may be rejected if judged to be too complex. Proposers for programmes requiring timing links are strongly encouraged to consider how they may simplify their timing-sequences as much as possible, as this will minimize the risk that the observations are deemed unfeasible. If a given OB cannot be executed within its intended observability window, ESO will try to execute it as soon as possible thereafter on a best-effort basis, taking into account the user-specified constraints and the constraints imposed by other scheduled runs. ESO will not restart a sequence of linked observations if the pre-specified timing constraints cannot be fulfilled.
- **Split runs with targets at widely different positions:** It must be recalled that, according to the current procedure for the final release of SM data packages, the complete data distribution takes place only after the run is completed. It is thus advisable to split runs with targets in two widely separated regions of the sky, so that the distribution of data for the targets observable at the beginning of the period can already take place before the observations for targets observable at the end of the period are completed. This does not apply to the direct access that PIs now have via their User Portal account to their SM raw data.
- **VLTI:** For VLTI observations, a separate run must be specified for each requested baseline.

13 Policy Summary

Several policies regarding all aspects of use of ESO telescopes have been refined over the years by the ESO Observing Programmes Committee (OPC), and by the Scientific Technical Committee (STC). Here we summarize those policies relevant for ESO proposers for Period 86. For details on individual policies we refer to the **VLT/VLTI Science Operations Policy** document.

13.1 Who may submit, time allocation policies

ESO proposals may be submitted by any group or individual. One single person, the *Principal Investigator* or PI, must be assigned to be principally responsible for the programme. The PI will also act as the official contact between ESO and the proposers for all later correspondence (*e.g.* Phase 2 information, data distribution). By submitting a proposal, the PI takes full responsibility for its contents, in particular with regard to the names of CoIs and the agreement to act according to the ESO policies and regulations, including the conditions specified in the present Call for Proposals. Following the introduction of the ESO User Portal, PIs identify themselves uniquely in Phase 1 proposals by their User Portal username. Note that each individual is allowed to have only one account in the User Portal database; multiple accounts should not be created or used by the same user. Failure to comply with this restriction may lead to the rejection by ESO of the proposals of the offending PI.

Any proposal received by ESO prior to the submission deadline will be reviewed by the OPC, who will rank them according to the following criteria:

- Scientific merit of the proposal and the importance of its contribution to the advancement of scientific knowledge.
- Evidence that detailed plans exist for complete and timely data analysis, and that the proposing individual or team will have sufficient time and resources to carry out the analysis.

Proposals should be self-contained. Their evaluation will be based solely on their explicit contents, to the exclusion of external references such as personal webpages, etc.

For non-member state proposals (Sect. 11.8) the following additional criteria will be taken into account:

- The required telescope/instrumentation is not available at any other observatory accessible to the applicants.
- If an ESO member state proposal and a non-member state proposal are rated equally, preference will be given to the ESO member state proposal.

The following policy, extracted from the agreement between ESO and its host state Chile, governs the allocation of time to *Host State Proposals* (Sect. 11.9): "Chilean scientists who present meritorious projects shall have the right to obtain up to 10% of the observing time of ESO telescopes". For VLT projects at least one half of this 10% shall be dedicated to projects of Chilean astronomers in cooperation with astronomers of ESO member countries.

Following the recommendations of the OPC and a technical feasibility check, the ESO Director General grants observing time based on OPC ranking and availability. However, in the case of sudden astronomical events a ToO or DDT programme may be activated, and exceptionally take priority, leading to an interruption of the currently active run.

13.2 Requesting use of non-standard observing configurations

Proposers should pay particular attention to the fact that, as indicated in the instrument manuals, use of certain non-standard instrumental modes or configurations requires prior approval by ESO. This approval must be obtained before submitting the Phase 1 proposal. Corresponding requests, including a brief justification, must be submitted by email to **esoform@eso.org** at least two weeks before the proposal submission deadline. Failure to follow this rule may lead to the rejection of the proposal by ESO for technical reasons.

13.3 Policy regarding offered/available observing configurations

For Paranal, it is ESO's intention to offer all the most frequently utilized instrument configurations and modes in both Service and Visitor Mode. Users will be promptly informed if it becomes impossible to support some currently offered instrument mode, and may be asked to switch from Service Mode to Visitor Mode or vice versa. In general, runs requiring non-standard configurations will not be accepted in Service Mode.

13.4 Observing programme execution

Observations in both Visitor and Service Mode must be executed as described in the Phase 1 proposal, including the instrument modes and specified targets. Departures from Phase 1 specifications and targets will not generally be allowed, unless a sound scientific justification exists, and provided that the change does not involve a significant increase in the pressure factor on oversubscribed regions of the sky. The request for changes of targets and instrument set-up(s), along with the corresponding scientific justification, must be submitted via the web-based form available at **http://www.eso.org/sci/observing/phase2/ProgChange/**. For any other departure from Phase 1 specifications, such justification must be provided by writing to **paranal@eso.org** at least one month before the beginning of the observations for runs scheduled in Visitor Mode. For Service Mode runs, these requests and associated justifications must be submitted to **usd-help@eso.org** or to **p2pp-waiver@eso.org** (clear instructions are available at **http://www.eso.org/sci/observing/phase2/WaiverChanges.html**) at least one week before the Phase 2 deadline. ESO reserves the right to reject the changes if insufficiently justified, if conflicting with any other approved programmes, or if they imply significant changes in the overall distribution of scheduled targets in the sky. Observations of targets for which no authorization has been obtained are not allowed at the telescope.

13.4.1 Service Mode run execution

On the basis of OPC ranking, the runs to be conducted in Service Mode will be subdivided, for operational reasons, into the following Classes:

- **Class A:** All possible effort will be made to execute all OBs corresponding to the runs in the requested observing period. Approximately the first half (according to the OPC ranking) of the total amount of Service Mode time scheduled on each telescope falls in this Class.
- **Class B:** Best effort will be made to have these runs conducted in the requested observing period. Approximately the second half (according to the OPC ranking) of the total amount of Service Mode time scheduled on each telescope falls in this Class.
- **Class C:** Filler runs. OBs will only be executed if the observing conditions do not permit observations for runs within Classes A and B.

For Class A runs which are not completed by the end of Period 86, ESO will decide whether they can be declared "substantially complete", or have to be carried over to the next period provided that this is technically feasible. In general, a class A run will not be carried over for more than one additional natural visibility period. Class B and C runs will not be carried over. ToO runs are by definition Class A regarding priority in execution but they will not be carried over to the following Periods regardless of their completion status.

13.4.2 ToO programme execution

As for any other Service Mode run, successful proposers of ToO runs will have to prepare OBs for their observations well ahead of the beginning of an observing period (see Sect. 12.2). Mostly ToO OBs will have to be "dummy" OBs with default values for target coordinates, integration times etc. At the time of occurrence of the predicted event, the PI of the programme must activate it and at the same time provide the missing information for completion of the OBs. The service observer will update and execute the specified OBs.

13.5 Phase 2 Service Mode policy: Constraints and targets are binding

To optimize the use of ESO telescopes in Service Mode a proper mix of runs requiring various observing conditions, and with targets spread over the entire range of RAs for a given period, is necessary. For this reason proposers are requested in their Phase 1 proposal to specify not only the targets with accurate coordinates, but also the needed observing conditions (lunar phase, seeing, sky transparency). **Due to their essential role in determining the long-term scheduling of Service Mode time, the constraints specified at Phase 1 are binding**. Successful proposers will not be allowed to change the constraints, instrument set-ups, target lists and/or times per target that were requested at Phase 1 in their Phase 2 submissions, unless explicitly authorized by ESO (see Sect. 13.4).

13.6 Pre-imaging runs

A separate pre-imaging run must be specified for VLT programmes for which pre-imaging is required. If this is not specified in the proposal, the time needed for the execution of the pre-imaging will be deducted from the total allocation of the project. Pre-imaging runs are always scheduled in priority class A but, in case that the pre-imaging run is not specified separately, this will not happen automatically. In such cases, there is a risk that pre-imaging might not be identified as such until a later time. For this reason, please be sure to indicate the pre-imaging character of the run by using the corresponding `\INSconfig` macro in the LaTeX ESOFORM template.

13.7 Data rights, archiving, data distribution

All data are ESO property. ESO grants a twelve month proprietary period for science and acquisition data to the PI of the programme as part of which these data were obtained. This period applies to each exposure individually. The period starts as files are being made available to (or retrieved by) PIs. For Visitor Mode runs, it starts at the time of the observation; while for Service Mode runs, as soon as any data are made available to the PI. The latter refers to the standard SM data package (usually shipped to the PI once the run is completed) and/or to any PI direct request for proprietary raw data via his/her User Portal account during the period. Should you wish to specify a shorter period than the nominal 12 months in Period 86, please do so using the `\ProprietaryTime` macro in the LaTeX ESOFORM template. Calibration and technical data are not subjected to proprietary period and become publicly available as soon as they are ingested in the ESO Archive.

For Visiting Astronomers, raw data will in general be made available before astronomers leave the Observatory site. In the case of Service Mode observations, data products, raw data, calibration data and any associated pipeline calibrated data will be distributed to the programme PI at the conclusion of their Service Mode run.

SPECIAL NOTE: Since ESO has recently revised some of its data distribution procedures, we clearly spell out the current rules here.

- As a general rule, Service Mode data packages are distributed upon completion of a given run or at the end of the period, whatever comes first. An additional overhead for data processing has to be taken into account. At the end of a semester data from all Service Mode runs will be distributed.
- The exceptions to the general rule are ToO data and pre-imaging data, which are made available to the PI via FTP directly from the archive. This automatic service will normally take place within a maximum of 48 hours from the observing time.
- Service Mode PIs have direct access to their proprietary data via their User Portal account. Data can be made available to the PI as soon as they have been safely archived in the ESO Science Archive in Garching.
- The proprietary period for Service Mode data starts when the data is made available for the first time to the user (this also includes archive requests submitted during the period in order to access proprietary data).

13.8 Publication of ESO telescope results

Publications based on observations collected at ESO telescopes should state this in a footnote to the article's title. The corresponding observing proposal should be clearly identified by its ESO reference number. For example: *"Based on observations collected at the European Southern Observatory, Chile (ESO Programme 086.C-1234)"*.

13.9 Press Releases

Should you consider that your results are worthy of a press release to the general public, please contact the ESO Outreach Department (**information@eso.org**) as soon as possible, preferably no later than when the paper is submitted for publication. ESO reserves the right to use any data obtained with ESO telescopes as part of programmes allocated ESO time for press releases.

Part IV

Appendix

A Acronyms

4QPM	Four Quadrant Phase Mask
ADP	Advanced Data Products
AMBER	Astronomical Multi-BEam combineR
APEX	Atacama Pathfinder EXperiment
APEX-SZ	APEX Sunyaev Zel'Dovich camera
APP	Apodizing Phase Plate
AT	Auxiliary Telescope for the VLT Interferometer
CHAMP+	Carbon Heterodyne Array of the MPIfR
CoI	Co-Investigator
CONICA	High-Resolution Near Infrared CAmera
CRIRES	Cryogenic high-resolution IR Echelle Spectrometer
DDT	Director's Discretionary Time (proposal)
DIT	Discrete Integration Time
DPS	Deep Public Survey
EIS	ESO Imaging Survey
EFOSC2	ESO Faint Object Spectrograph and Camera
ESO	European Southern Observatory
ETC	Exposure Time Calculator
FEROS	Fibre-fed Extended Range Optical Spectrograph
FFTS	Fast Fourier Transform Spectrometer
FIMS	FORS Instrumental Mask Simulator
FINITO	Fringe Tracking Instrument of NIzza and TOrino
FLAMES	Fibre Large Array Multi Element Spectrograph
FLASH	First-Light Apex Sub-millimetre Heterodyne
FLI	Fraction of Lunar Illumination
FORS1	Focal Reducer/low dispersion Spectrograph 1
FORS2	Focal Reducer/low dispersion Spectrograph 2
FOV	Field Of View
GTC	Gran Telescopio Canarias
GTO	Guaranteed Time Observations
HARPS	High Accuracy Radial velocity Planet Searcher
HAWK-I	High Acuity Wide field K-band Imager
IB	Intermediate Band
IFU	Integral Field Unit
IR	InfraRed
ISAAC	Infrared Spectrometer And Array Camera
KMOS	K-band Multi-Object Spectrograph
LABOCA	LArge BOlometer CAmera
LADC	Linear Atmospheric Dispersion Compensator
LGS	Laser Guide Star
LST	Local Sidereal Time
LW	Long Wavelength (in the IR)
MIDI	MID-infrared Interferometric instrument
MOS	Multi Object Spectroscopy
MPG	Max Planck Gesellschaft
MPIfR	Max Planck Institut für Radioastronomie
NACO	NAOS-CONICA
NAOS	Nasmyth Adaptive Optics System
NB	Narrow Band
NGS	Natural Guide Star

OB	Observation Block
OPC	Observing Programmes Committee
OPO	Observing Programmes Office (formerly VISAS)
P2PP	Phase 2 Proposal Preparation (software tool)
PI	Principal Investigator
PWV	Precipitable Water Vapour
RRM	Rapid Response Mode
SABOCA	Submillimetre APEX BOlometer CAmera
SAM	Sample Aperture Mask
SDI	Simultaneous Differential Imager
SE	Seeing Enhancer
SHFI	Swedish Heterodyne Facility Instrument
SINFONI	Spectrograph for INtegral Field Observations in the Near Infrared
SM	Service Mode (programme)
STC	Scientific Technical Committee
SPHERE	Spectro-Polarimetric High-contrast Exoplanet REsearch
SV	Science Verification
SW	Short Wavelength (in the IR)
ToO	Target of Opportunity
USD	User Support Department
UT1	Unit Telescope 1 (Antu)
UT2	Unit Telescope 2 (Kueyen)
UT3	Unit Telescope 3 (Melipal)
UT4	Unit Telescope 4 (Yepun)
UV	Ultra Violet
UVES	UV–Visual Echelle Spectrograph
VIMOS	VIsible MultiObject Spectrograph
VIRCAM	VISTA InfraRed CAMera
VISIR	VLT Imager and Spectrometer for mid Infra Red
VISTA	Visible and Infrared Survey Telescope for Astronomy
VLT	Very Large Telescope
VLTI	Very Large Telescope Interferometer
VM	Visitor Mode (programme)
VST	VLT Survey Telescope
WFI	Wide Field Imager
XSHOOTER	UV-Visual-NIR medium resolution echelle spectrograph

(end of document)